# RED SEAL

THE INTERPROVINCIAL STANDARDS RED SEAL PROGRAM

## National Occupational Analysis

2009

# Industrial Mechanic (Millwright)

Human Resources and Skills Development Canada
Ressources humaines et Développement des compétences Canada
Canada

**Occupational Analyses Series**

# Industrial Mechanic (Millwright)

**2009**

| | |
|---|---|
| Trades and Apprenticeship Division | Division des métiers et de l'apprentissage |
| Workplace Partnerships Directorate | Direction des partenariats en milieu de travail |
| National Occupational Classification: | 7311 |
| Disponible en français sous le titre : | Mécanicien industriel/mécanicienne industrielle (de chantier) |

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# FOREWORD

***The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this National Occupational Analysis as the national standard for the occupation of Industrial Mechanic (Millwright).***

## Background

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to cooperate with provincial and territorial apprenticeship committees and officials in preparing analyses of a number of skilled occupations. To this end, Human Resources and Skills Development Canada (HRSDC) sponsors a program, under the guidance of the Canadian Council of Directors of Apprenticeship (CCDA), to develop a series of national occupational analyses.

The National Occupational Analyses have the following objectives:

- to describe and group the tasks performed by skilled workers;
- to identify which tasks are performed in every province and territory;
- to develop instruments for use in the preparation of Interprovincial Red Seal Examinations and curricula for training leading to the certification of skilled workers;
- to facilitate the mobility of apprentices and skilled workers in Canada; and,
- to supply employers, employees, associations, industries, training institutions and governments with analyses of occupations.

# ACKNOWLEDGEMENTS

The Canadian Council of Directors of Apprenticeship (CCDA) and Human Resources and Skills Development Canada (HRSDC) wish to express sincere appreciation for the contribution of the many tradespersons, industrial establishments, professional associations, labour organizations, provincial and territorial government departments and agencies, and all others who contributed to this publication.

This analysis was prepared by the Workplace Partnerships Directorate of HRSDC. The coordinating, facilitating and processing of this analysis were undertaken by employees of the National Occupational Analysis (NOA) development team of the Trades and Apprenticeship Division.

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# LIST OF PUBLISHED NATIONAL OCCUPATIONAL ANALYSES (Red Seal Trades)

| TITLE | NOC* Code |
|---|---|
| Agricultural Equipment Technician (2007) | 7312 |
| Appliance Service Technician (2005) | 7332 |
| Automotive Painter (2009) | 7322 |
| Automotive Service Technician (2009) | 7321 |
| Baker (2006) | 6252 |
| Boilermaker (2008) | 7262 |
| Bricklayer (2007) | 7281 |
| Cabinetmaker (2007) | 7272 |
| Carpenter (2005) | 7271 |
| Concrete Finisher (2006) | 7282 |
| Construction Craft Worker (2009) | 7611 |
| Construction Electrician (2008) | 7241 |
| Cook (2008) | 6242 |
| Electrical Rewind Mechanic (1999) | 7333 |
| Electronics Technician – Consumer Products (1997) | 2242 |
| Floorcovering Installer (2005) | 7295 |
| Glazier (2008) | 7292 |
| Hairstylist (2009) | 6271 |
| Heavy Duty Equipment Technician (2004) | 7312 |
| Industrial Electrician (2008) | 7242 |
| Industrial Mechanic (Millwright) (2009) | 7311 |
| Instrumentation and Control Technician (2007) | 2243 |
| Insulator (Heat and Frost) (2007) | 7293 |
| Ironworker (Generalist) (2006) | 7264 |
| Ironworker (Reinforcing) (2006) | 7264 |
| Ironworker (Structural/Ornamental) (2006) | 7264 |
| Lather (Interior Systems Mechanic) (2007) | 7284 |

* National Occupational Classification

| TITLE | NOC* Code |
|---|---|
| Machinist (2005) | 7231 |
| Metal Fabricator (Fitter) (2008) | 7263 |
| Mobile Crane Operator (2009) | 7371 |
| Motorcycle Mechanic (2006) | 7334 |
| Motor Vehicle Body Repairer (Metal and Paint) (2005) | 7322 |
| Oil Heat Systems Technician (2006) | 7331 |
| Painter and Decorator (2007) | 7294 |
| Partsperson (2005) | 1472 |
| Plumber (2008) | 7251 |
| Powerline Technician (2009) | 7244 |
| Recreation Vehicle Service Technician (2006) | 7383 |
| Refrigeration and Air Conditioning Mechanic (2009) | 7313 |
| Rig Technician (2008) | 8232 |
| Roofer (2006) | 7291 |
| Sheet Metal Worker (2006) | 7261 |
| Sprinkler System Installer (2009) | 7252 |
| Steamfitter — Pipefitter (2008) | 7252 |
| Tilesetter (2004) | 7283 |
| Tool and Die Maker (2005) | 7232 |
| Transport Trailer Technician (2008) | 7321 |
| Truck and Transport Mechanic (2007) | 7321 |
| Welder (2009) | 7265 |

**Requests for printed copies of National Occupational Analyses may be forwarded to:**

Trades and Apprenticeship Division
Workplace Partnership Directorate
Human Resources and Skills Development Canada
140 Promenade du Portage, Phase IV, 5th Floor
Gatineau, Quebec K1A 0J9

**These publications can be ordered or downloaded online at: www.red-seal.ca. Links to Essential Skills Profiles for some of these trades are also available on this website.**

# STRUCTURE OF ANALYSIS

To facilitate understanding of the occupation, the work performed is divided into the following categories:

| | |
|---|---|
| **Block** | the largest division within the analysis which reflects a distinct set of operations relevant to the occupation. |
| **Task** | the distinct activity that, combined with others, makes up the logical and necessary steps the worker is required to perform in a block. |
| **Sub-Task** | the smallest division of work activities that, combined together, fully describe all duties of a task. |
| **Supporting Knowledge and Abilities** | the elements of skill and knowledge that an individual must acquire to adequately perform a sub-task. |

Information on the following areas of this occupation is also provided throughout the analysis:

| | |
|---|---|
| **Trends** | any shifts or changes in technology that affect the block. |
| **Related Components** | components related to a specified task being undertaken. |
| **Tools and Equipment** | types of tools and equipment necessary to perform the work on all given tasks identified within the block. More detailed lists of these types are shown in Appendix A. |
| **Context** | statements written to clarify the intent and meaning of tasks. |

The appendices located at the end of the analysis are described as follows:

| | |
|---|---|
| **Appendix A – Tools and Equipment** | a non-exhaustive list of tools and equipment used in this trade. |
| **Appendix B – Glossary** | definitions or explanations for terms used in this analysis. |
| **Appendix C – Acronyms** | a list of acronyms used in this analysis with their full name. |
| **Appendix D – Block and Task Weighting** | the block and task percentages as submitted by each jurisdiction at the validation stage and the national averages of these percentages. |
| **Appendix E – Pie Chart** | a graph which depicts the national percentages assigned to blocks. |
| **Appendix F – Task Profile Chart** | a chart which outlines graphically the blocks, tasks and sub-tasks of this analysis. |

# DEVELOPMENT AND VALIDATION OF ANALYSIS

## Development of Analysis

A draft analysis is developed by a committee of industry experts in the field led by a team of facilitators from HRSDC. This draft analysis breaks down all the tasks performed in the occupation and describes the knowledge and abilities required for a tradesperson to demonstrate competence in the trade.

The NOA development team then forwards a copy of the analysis and its translation to provincial/territorial authorities for a review of its content and structure. Their recommendations are assessed and incorporated into the analysis.

## Validation and Weighting Method

This copy of the analysis is sent to all provinces/territories for validation and weighting. Each jurisdiction validates the document with the use of a provincial/territorial trade advisory committee. They examine the blocks, tasks and sub-tasks of the analysis:

**BLOCKS** Each committee assigns percentages to blocks based on the number of questions that they would assign for each block on a hundred question examination of the entire trade.

**TASKS** Each committee assigns percentages to tasks based on the number of questions that would be assigned to each task on a hundred question examination for its block.

**SUB-TASKS** Sub-tasks are examined by each committee and they indicate with a YES or NO whether or not each sub-task is performed by the skilled workers within the occupation in their jurisdiction.

The results of this exercise are submitted to the NOA development team who then analyzes the data and incorporates it into the document. The analysis provides the individual jurisdictional validation results as well as the national averages of all responses. The national averages for block and task weighting provide guidelines for the development of the Interprovincial Red Seal Examination for the trade.

This method for the validation of the National Occupational Analysis also identifies common core sub-tasks across Canada for the occupation. If at least 70% of the responding jurisdictions perform a sub-task, it shall be considered common core. Interprovincial Red Seal Examinations are based on the common core sub-tasks identified through this validation process.

## Definitions for Validation and Weighting

| | |
|---|---|
| **YES** | sub-task is performed by qualified workers in the occupation in a specific jurisdiction. |
| **NO** | sub-task is not performed by qualified workers in the occupation in a specific jurisdiction. |
| **NV** | Not Validated by a province/territory. |
| **ND** | Not Designated in a province/territory. |
| **NOT COMMON CORE (NCC)** | sub-task, task or block is performed by less than 70% of responding jurisdictions; these are not to appear on the Interprovincial Red Seal Examination for this trade. |
| **BLOCK %** | the average percentage of questions that will be placed on an Interprovincial Red Seal Examination to assess each block of the analysis. |
| **TASK %** | the average percentage of questions that will be placed on an Interprovincial Red Seal Examination to assess each task of the analysis. |

## Provincial/Territorial Abbreviations

| | |
|---|---|
| **NL** | Newfoundland and Labrador |
| **NS** | Nova Scotia |
| **PE** | Prince Edward Island |
| **NB** | New Brunswick |
| **QC** | Quebec |
| **ON** | Ontario |
| **MB** | Manitoba |
| **SK** | Saskatchewan |
| **AB** | Alberta |
| **BC** | British Columbia |
| **NT** | Northwest Territories |
| **YT** | Yukon Territory |
| **NU** | Nunavut |

# ANALYSIS

Safe working procedures and conditions, accident prevention, and the preservation of health are of primary importance to industry in Canada. These responsibilities are shared and require the joint efforts of government, employers and employees. It is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and work environments can be created by controlling the variables and behaviours that may contribute to accidents or injury.

It is generally recognized that safety-conscious attitudes and work practices contribute to a healthy, safe and accident-free work environment.

It is imperative to apply and be familiar with the Occupational Health and Safety Acts and Workplace Hazardous Materials Information System (WHMIS) Regulations. As well, it is essential to determine workplace hazards and take measures to protect oneself, co-workers, the public and the environment.

Safety education is an integral part of training in all jurisdictions. As safety is an imperative part of all trades, it is assumed and therefore it is not included as a qualifier of any activities. However, the technical safety tasks and sub-tasks specific to the trade are included in this analysis.

# SCOPE OF THE INDUSTRIAL MECHANIC (MILLWRIGHT) TRADE

"Industrial mechanic (Millwright)" is this trade's official Red Seal occupational title approved by the CCDA. This analysis covers tasks performed by industrial mechanics (millwrights) whose occupational title has been identified by some provinces and territories of Canada under the following names:

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Industrial Mechanic (Millwright) | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| Industrial Mechanic (Millwright) (Construction) | | | | | ✓ | | | | | | | | |
| Industrial Mechanic (Millwright) (Non-Construction) | | | | | ✓ | | | | | | | | |
| Millwright | | | | | | | | | ✓ | ✓ | | | |

Industrial mechanics (millwrights) work on industrial machinery and mechanical equipment. This equipment may include mechanical, pneumatic, hydraulic, fuel, lubrication, cooling and exhaust systems and equipment. Some components worked on include pumps, fans, tanks, conveyors, presses, generators, and pneumatic and hydraulic controls.

Industrial mechanics (millwrights) are responsible for assembling, installing, aligning, maintaining, repairing, troubleshooting, inspecting, dismantling and moving this machinery and equipment. Troubleshooting may include diagnosing irregularities and malfunctions, making adjustments, and repairing or replacing parts. Cleaning, adjusting and lubricating machinery are also important maintenance tasks of the trade.

Other tasks that may be performed in this trade include welding, cutting and machining as required. Industrial mechanics (millwrights) may prepare bases for equipment.

Prints, diagrams, schematic drawings and manuals assist industrial mechanics (millwrights) in determining work procedures.

Industrial mechanics (millwrights) work with a wide variety of tools. They may use hand and power tools in installation and repair work. Larger machine tools such as lathes, drill presses and grinders may be used in fabrication of machine parts. Hoisting and lifting equipment such as cranes, jacks and forklifts is commonly used to position large machines or machine parts.

Industrial mechanics (millwrights) are employed in industrial maintenance or construction sectors. Millwrights employed in the construction industry are generally engaged in the initial installation of machinery and equipment. Those working in the industrial sector are employed in manufacturing or processing plants, utilities or other industrial establishments and are involved with the installation, maintenance and repair of machinery and equipment. Industrial mechanics can also be employed in light industry sectors such as grain/wheat handling.

The work environment for industrial mechanics (millwrights) is varied and may involve working in extreme or adverse conditions. They may work in confined spaces, at heights, with heavy equipment and around moving machinery. The work often requires considerable standing, kneeling and lifting of heavy materials.

Key skills for people in this trade are mechanical aptitude, problem-solving, communication, job planning and organizing and the ability to use trade-related calculations. They have the ability to detect malfunctions through sensory tests which are often confirmed by technical tests. Other important attributes include good coordination, manual dexterity and the ability to visualize a layout in three dimensions.

Industrial mechanics (millwrights) often possess overlapping skills with other trades such as steamfitter/pipefitter, industrial instrument mechanic, welder, machinist or industrial electrician. They may be certified in these other trades as well. Industrial mechanics (millwrights) may work in specialized areas of the trade such as fluid analysis, vibration analysis and laser alignment. With experience, they may advance to other positions such as mentor, supervisor, planner, superintendent or trainer.

## OCCUPATIONAL OBSERVATIONS

Newer, more sophisticated equipment will require a higher level of skill of industrial mechanics (millwrights) and they will need to keep pace with these changes. For example, some machines allow for self-diagnosis and predictive maintenance. There is a higher emphasis on in-house training when new machines and equipment are acquired.

There is a wider variety of materials available for use in the construction of machinery and components, such as new alloys and advanced plastics. More types of sealant materials are available to the industrial mechanic (millwright).

Preventative and predictive maintenance planning is seen as more important and scheduled shutdowns are more prevalent.

Some hand and power tools are more ergonomically designed to prevent repetitive strain injuries. Many power tools are now cordless and of light weight design. There is also a much greater usage of mobile equipment such as forklifts, scissor lifts, aerial lifts and lift trucks in the trade.

Diagnostic equipment and tools such as computerized laser alignment equipment and vibration analyzers are becoming more technically advanced. Acoustic monitoring technology is advancing rapidly. Borescopes are increasingly used to view and troubleshoot internal components. There is advanced diagnostic equipment for fluid power inspection such as handheld analyzers and clamp-on flowmeters.

Personal protective equipment is becoming more user-friendly resulting in increased usage among tradespersons. Improved identification of hazardous materials through increased use of Material Safety Data Sheets (MSDS) contributes to a safer work environment. Safety is becoming a higher priority in the workplace due to increased awareness of hazards.

**Trends**

With advancements in material composition and laser measuring devices, industrial mechanics (millwrights) are able to achieve efficiencies and high degrees of accuracy in their work.

Computerized maintenance tracking systems are more common in the workplace.

**Related Components**

All components apply.

**Tools and Equipment**

See Appendix A.

## Task 1 Maintains tools and equipment.

**Context**

Industrial mechanics (millwrights) maintain various tools and equipment to ensure optimal efficiency and safe operation of tools.

**Sub-task 1.01** **Maintains hand tools.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 1.01.01 | knowledge of types of hand tools such as files, hacksaws, chisels and hammers |
| 1.01.02 | knowledge of hand tool operating procedures |
| 1.01.03 | knowledge of limitations of use of hand tools |
| 1.01.04 | ability to organize hand tools |
| 1.01.05 | ability to store hand tools |
| 1.01.06 | ability to recognize worn, damaged or defective hand tools |
| 1.01.07 | ability to clean and lubricate hand tools |

**Sub-task**
**1.02** **Maintains portable power tools.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 1.02.01 | knowledge of power tools and accessories such as die grinders, impact wrenches, hydraulic wrenches, portable drills and power threaders |
| 1.02.02 | knowledge of power tool operating procedures |
| 1.02.03 | knowledge of limitations of use of power tools |
| 1.02.04 | ability to organize power tools |
| 1.02.05 | ability to store power tools |
| 1.02.06 | ability to recognize worn, damaged or defective power tools |
| 1.02.07 | ability to clean and lubricate power tools |

**Sub-task**
**1.03** **Maintains shop machines.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 1.03.01 | knowledge of shop machines such as drill presses, stationary grinders, chop saws, lathes, milling machines and band saws |
| 1.03.02 | knowledge of shop machine operating procedures |
| 1.03.03 | knowledge of limitations of use of shop machines |
| 1.03.04 | ability to recognize unsafe, worn, damaged or defective shop machines |
| 1.03.05 | ability to clean and lubricate shop machines |

**Sub-task**

**1.04** **Maintains precision measuring tools.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 1.04.01 | knowledge of precision measuring tools and accessories such as laser measuring devices, micrometers, vernier calipers, feeler gauges, telescoping gauges, protractors and dial gauges |
| 1.04.02 | knowledge of precision measuring tool operating procedures |
| 1.04.03 | knowledge of limitations of use of precision measuring tools |
| 1.04.04 | ability to verify and set calibration of precision measuring tools |
| 1.04.05 | ability to organize precision measuring tools |
| 1.04.06 | ability to store precision measuring tools |
| 1.04.07 | ability to recognize worn, damaged or defective precision measuring tools |
| 1.04.08 | ability to clean and lubricate precision measuring tools |

**Sub-task**

**1.05** **Maintains layout tools.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 1.05.01 | knowledge of layout tools such as straightedges, height gauges, solid square, combination square, combination set, protractors, optical equipment and tape measures |
| 1.05.02 | knowledge of layout tool operating procedures |
| 1.05.03 | knowledge of limitations of layout tools |
| 1.05.04 | ability to organize layout tools |
| 1.05.05 | ability to store layout tools |
| 1.05.06 | ability to recognize worn, damaged or defective layout tools |
| 1.05.07 | ability to clean layout tools |

**Sub-task**

**1.06** **Maintains access equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 1.06.01 | knowledge of access equipment such as ladders, scaffolds, aerial lifts and scissor lifts |
| 1.06.02 | knowledge of access equipment operating procedures |
| 1.06.03 | knowledge of limitations of access equipment |
| 1.06.04 | ability to store access equipment |
| 1.06.05 | ability to recognize unsafe, worn, damaged or defective access equipment |
| 1.06.06 | ability to clean and lubricate access equipment |

**Sub-task**

**1.07** **Maintains personal protective equipment (PPE) and safety equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 1.07.01 | knowledge of types of PPE such as safety glasses, gloves, face shields, hearing protection, respiratory equipment, safety footwear and hard hats |
| 1.07.02 | knowledge of safety equipment such as fall arrest devices, first aid kit and eye wash station |
| 1.07.03 | knowledge of workplace safety and health regulations |
| 1.07.04 | knowledge of PPE and safety equipment operations |
| 1.07.05 | knowledge of limitations of use of PPE and safety equipment |
| 1.07.06 | ability to organize PPE and safety equipment |
| 1.07.07 | ability to store PPE and safety equipment |
| 1.07.08 | ability to recognize worn, damaged or defective PPE and safety equipment |
| 1.07.09 | ability to clean PPE and safety equipment |

## Task 2 — Organizes work.

**Context** Industrial mechanics (millwrights) use organizational skills to perform their tasks in a safe, efficient and effective manner.

---

**Sub-task 2.01** — **Uses documentation.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 2.01.01 | knowledge of types of documentation such as work orders, purchase orders, parts lists and procedure documentation |
| 2.01.02 | knowledge of standards codes such as the Canadian Standards Association (CSA), American Society for Testing and Materials (ASTM) and The American National Standards Institute (ANSI) codes |
| 2.01.03 | knowledge of Workplace Hazardous Materials Information System (WHMIS) documentation such as Material Safety Data Sheets (MSDS) and labels |
| 2.01.04 | knowledge of WHMIS symbols such as flammable, poisonous and corrosive |
| 2.01.05 | ability to locate and interpret manufacturers' specifications |
| 2.01.06 | ability to interpret standards and codes |
| 2.01.07 | ability to access and interpret information such as MSDS sheets and work orders |

---

**Sub-task 2.02** — **Uses drawings and schematics.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 2.02.01 | knowledge of symbols and conventions used in drawings and schematics |
| 2.02.02 | knowledge of metric and imperial systems |
| 2.02.03 | ability to determine and recognize parts from engineering drawings |

| | |
|---|---|
| 2.02.04 | ability to read, understand and cross-reference engineering drawings, schematics and sketches, specifications and technical manuals |
| 2.02.05 | ability to perform trade-related calculations |
| 2.02.06 | ability to produce field drawings and freehand schematic drawings |

---

**Sub-task**
**2.03** **Identifies job requirements.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 2.03.01 | knowledge of established job requirements such as personnel and schedule of operations |
| 2.03.02 | ability to determine task and personnel requirements |
| 2.03.03 | ability to schedule work with other tradespersons and personnel |
| 2.03.04 | ability to estimate time to complete tasks |
| 2.03.05 | ability to determine the types of tools needed |
| 2.03.06 | ability to identify required materials and equipment |

---

**Sub-task**
**2.04** **Communicates with others.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 2.04.01 | knowledge of trade terminology |
| 2.04.02 | knowledge of verbal and written communication skills |
| 2.04.03 | ability to communicate with supervisors and planners |
| 2.04.04 | ability to consult with clients, colleagues and tradespersons |
| 2.04.05 | ability to mentor apprentices |

**Sub-task**

**2.05 Maintains safe work environment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 2.05.01 | knowledge of WHMIS |
| 2.05.02 | knowledge of locations of WHMIS manuals and MSDS |
| 2.05.03 | knowledge of workers' rights and responsibilities |
| 2.05.04 | knowledge of company safety policies and procedures |
| 2.05.05 | knowledge of federal, provincial/territorial and municipal health and safety acts and regulations |
| 2.05.06 | knowledge of training requirements such as fall protection and confined space entry |
| 2.05.07 | knowledge of fire safety and hot work permit procedures |
| 2.05.08 | knowledge of housekeeping practices |
| 2.05.09 | knowledge of emergency procedures and location of on-site first aid stations and equipment |
| 2.05.10 | knowledge of disposal and recycling procedures |
| 2.05.11 | ability to recognize personal injury hazards |
| 2.05.12 | ability to recognize and report potential hazards |
| 2.05.13 | ability to handle and store hazardous materials |
| 2.05.14 | ability to install temporary safety protection such as barrier tape and barricades |
| 2.05.15 | ability to identify and implement positive ventilation in workspace |
| 2.05.16 | ability to select and use self-contained breathing apparatus (SCBA) |

## Task 3 Performs routine trade tasks.

**Context** Industrial mechanics (millwrights) perform these trade tasks to ensure safety of workers and to optimize the efficiency and life expectancy of machinery.

---

**Sub-task 3.01** **Performs lockout procedures.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 3.01.01 | knowledge of safe practices for isolating equipment and achieving a zero energy state |
| 3.01.02 | knowledge of safe practices and policies for locking and tagging out equipment |
| 3.01.03 | ability to recognize and de-energize stored energy potential in components such as accumulators, suspended loads, and pneumatic and hydraulic cylinders |
| 3.01.04 | ability to follow recognized procedures for shutdown, tagging out and locking |

---

**Sub-task 3.02** **Fabricates workpiece.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 3.02.01 | knowledge of fabricating techniques |
| 3.02.02 | ability to identify fabrication requirements such as size, strength and materials required |
| 3.02.03 | ability to identify fit and assembly requirements |

| | |
|---|---|
| 3.02.04 | ability to use shop tools such as milling machines, surface grinders and lathes |
| 3.02.05 | ability to cut, drill, grind and weld workpiece as required |

---

**Sub-task**

**3.03 Operates shop machines.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 3.03.01 | knowledge of types of shop machines such as milling machines, drill presses, stationary grinders and lathes |
| 3.03.02 | knowledge of shop machine components |
| 3.03.03 | knowledge of speeds and feeds |
| 3.03.04 | knowledge of machine tool operations |
| 3.03.05 | knowledge of hazards associated with shop machines |
| 3.03.06 | ability to set up shop machines |
| 3.03.07 | ability to apply coolants and cutting fluids |
| 3.03.08 | ability to identify fit and assembly requirements |
| 3.03.09 | ability to cut, drill, machine and grind workpiece as required |

---

**Sub-task**

**3.04 Uses access equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 3.04.01 | knowledge of types of access equipment such as ladders, scaffolds, aerial lifts and scissor lifts |
| 3.04.02 | knowledge of safety policies and procedures |
| 3.04.03 | knowledge of limitations of access equipment |
| 3.04.04 | ability to select access equipment |

| | |
|---|---|
| 3.04.05 | ability to select safety equipment |
| 3.04.06 | ability to recognize unstable conditions such as soft ground and ramps |

---

**Sub-task**
**3.05** **Lubricates systems and components.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 3.05.01 | knowledge of lubricating systems and components |
| 3.05.02 | knowledge of lubricant qualities such as viscosity and drop points |
| 3.05.03 | ability to determine lubricants/fluid requirements from specifications and technical manuals |
| 3.05.04 | ability to identify points requiring lubricants |
| 3.05.05 | ability to select proper lubricants and fluids |
| 3.05.06 | ability to maintain lubricant and fluid levels |
| 3.05.07 | ability to clean systems and components |
| 3.05.08 | ability to remove and replace lubricants and fluids |

---

**Sub-task**
**3.06** **Aligns components and systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 3.06.01 | knowledge of optical and mechanical alignment practices |
| 3.06.02 | ability to use alignment tools such as straightedges, feeler gauges, piano wire, transit, dial indicator and laser alignment equipment |
| 3.06.03 | ability to use levelling tools such as optical, laser and spirit levels |
| 3.06.04 | ability to align machinery and components according to manufacturers' specifications |
| 3.06.05 | ability to shim machinery and components |
| 3.06.06 | ability to record alignment data |

**Sub-task**

**3.07** **Uses fastening and retaining devices.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 3.07.01 | knowledge of the types of fastening devices such as nuts, bolts, rivets, screws and adhesives |
| 3.07.02 | knowledge of types of retaining devices such as keys, retaining rings, springs, dowels and pins |
| 3.07.03 | knowledge of fastening device characteristics and specifications |
| 3.07.04 | knowledge of torque values, tensile strength and metal capability |
| 3.07.05 | ability to achieve predetermined torque and/or stretching of fasteners by heat or cold |
| 3.07.06 | ability to identify threads with thread gauges |
| 3.07.07 | ability to select fastening and retaining devices |
| 3.07.08 | ability to identify and use tools to install or remove fastening and retaining devices |
| 3.07.09 | ability to select fluids and compounds associated with threaded fasteners |
| 3.07.10 | ability to clean, chase, plug, drill and tap threads |
| 3.07.11 | ability to restore threads using a thread restoration kit |

**Sub-task**

**3.08** **Tests metal and other materials using standardized procedures.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 3.08.01 | knowledge of the compatibility of metals and of other materials |
| 3.08.02 | knowledge of properties and characteristics of common types of metals and materials used in the trade |
| 3.08.03 | ability to select ferrous and non-ferrous metals and materials |

| | |
|---|---|
| 3.08.04 | ability to identify common types of metals by filing, chiselling and examining the chips (chisel test) |
| 3.08.05 | ability to identify common types of metal by grinding and examining the colour, shape and length of the sparks (spark test) |

---

**Sub-task**

**3.09 Performs heat treatment of metal.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | no | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 3.09.01 | knowledge of heat treatment procedures such as annealing, hardening, tempering and normalizing metals |
| 3.09.02 | knowledge of basic metallurgy |
| 3.09.03 | knowledge of safe practices for handling hot metals |
| 3.09.04 | ability to read and interpret heat treatment colour charts |
| 3.09.05 | ability to prepare component for heat treatment |
| 3.09.06 | ability to heat and cool workpiece for specified duration according to specifications |
| 3.09.07 | ability to clean workpiece |

## Task 4 — Performs measuring and layout.

**Context** Industrial mechanics (millwrights) ensure precise installation of equipment by utilizing measuring tools and measuring practices to lay out components and systems.

---

**Sub-task 4.01** — **Measures material and components using precision tools.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 4.01.01 | knowledge of types of precision measuring tools such as micrometers, vernier calipers and dial indicators |
| 4.01.02 | knowledge of purposes and applications of common precision measuring tools |
| 4.01.03 | ability to identify and use precision measuring tools for specific tasks |
| 4.01.04 | ability to take measurements using precision measuring tools |

---

**Sub-task 4.02** — **Places components using layout tools.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 4.02.01 | knowledge of types of layout tools such as optical levels, transits, protractors, straightedges, solid square, combination square, combination set, piano wire, batter board and plumb bobs |
| 4.02.02 | knowledge of purposes and applications of layout tools |
| 4.02.03 | ability to measure and record using layout tools |
| 4.02.04 | ability to lay out equipment according to specifications |

## Task 5 Uses cutting and welding equipment.

**Context** Industrial mechanics (millwrights) utilize welding and cutting equipment to heat, repair and fabricate components on machinery. Without welding certification, industrial mechanics (millwrights) do not perform structural and pressure welding.

---

**Sub-task 5.01** **Cuts material using gas cutting equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 5.01.01 | knowledge of gas cutting equipment |
| 5.01.02 | knowledge of basic cutting techniques using gas cutting equipment |
| 5.01.03 | knowledge of safe storage and handling of compressed gases |
| 5.01.04 | knowledge of gas cutting safety procedures such as setup, ventilation requirements and fire prevention |
| 5.01.05 | ability to identify material to be cut |
| 5.01.06 | ability to perform cutting procedures |
| 5.01.07 | ability to identify unsafe gas cutting equipment |

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**Sub-task 5.02** **Cuts material using plasma arc cutting equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| no | yes | yes | yes | yes | yes | yes | yes | no | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 5.02.01 | knowledge of plasma arc cutting equipment |
| 5.02.02 | knowledge of basic cutting using plasma arc cutting equipment |
| 5.02.03 | knowledge of safe storage and handling of compressed gases |
| 5.02.04 | knowledge of welding safety procedures such as ventilation requirements and fire prevention |
| 5.02.05 | knowledge of grounding requirements |

| | |
|---|---|
| 5.02.06 | ability to identify material to be cut |
| 5.02.07 | ability to perform plasma arc cutting procedures |
| 5.02.08 | ability to identify unsafe plasma arc cutting equipment |

---

**Sub-task**
**5.03** **Welds/brazes/solders material using gas welding equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 5.03.01 | knowledge of oxy-acetylene gas welding equipment |
| 5.03.02 | knowledge of basic welding, brazing and soldering using gas welding equipment |
| 5.03.03 | knowledge of safe storage and handling of compressed gases |
| 5.03.04 | knowledge of welding safety procedures such as ventilation requirements and fire prevention |
| 5.03.05 | ability to identify material to be welded, brazed or soldered |
| 5.03.06 | ability to determine compatibility of materials to be welded, brazed or soldered |
| 5.03.07 | ability to match rods and flux to materials to be welded, brazed or soldered |
| 5.03.08 | ability to perform welding, brazing and soldering procedures |
| 5.03.09 | ability to identify unsafe gas welding equipment |

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**Sub-task**
**5.04** **Welds material using arc welding equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 5.04.01 | knowledge of shielded metal arc welding (SMAW) procedures |
| 5.04.02 | knowledge of welding safety procedures such as ventilation requirements, fire prevention and electrical safety |
| 5.04.03 | knowledge of proper care and handling of arc welding equipment and electrodes |

| | |
|---|---|
| 5.04.04 | knowledge of alternating current (AC) and direct current (DC) welding |
| 5.04.05 | knowledge of grounding requirements |
| 5.04.06 | ability to select electrodes |
| 5.04.07 | ability to adjust amperage and polarity to achieve proper fusion and penetration |
| 5.04.08 | ability to identify material to be welded |
| 5.04.09 | ability to identify unsafe arc welding equipment |

---

**Sub-task**

**5.05 Welds material using metal inert gas (MIG) welding equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | no | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 5.05.01 | knowledge of MIG procedures |
| 5.05.02 | knowledge of welding safety procedures such as ventilation requirements, fire prevention and electrical safety |
| 5.05.03 | knowledge of grounding requirements |
| 5.05.04 | ability to adjust shielding gas, wire feed and speed, and amperage |
| 5.05.05 | ability to maintain proper gun angle |
| 5.05.06 | ability to identify material to be welded |
| 5.05.07 | ability to achieve proper fusion and penetration in all positions |
| 5.05.08 | ability to identify unsafe MIG welding equipment |

**Sub-task**

**5.06** **Welds material using tungsten inert gas (TIG) welding equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | no | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 5.06.01 | knowledge of TIG procedures |
| 5.06.02 | knowledge of common types of TIG welding equipment such as tungsten tips, filler rods and gases |
| 5.06.03 | knowledge of welding safety procedures such as ventilation requirements, fire prevention and electrical safety |
| 5.06.04 | knowledge of grounding requirements |
| 5.06.05 | ability to adjust shielding gas, tip, polarity and amperage |
| 5.06.06 | ability to maintain proper torch angle |
| 5.06.07 | ability to identify material to be welded |
| 5.06.08 | ability to achieve proper fusion and penetration in all positions |
| 5.06.09 | ability to identify unsafe TIG welding equipment |

## Task 6 — Prepares for installation and maintenance of components and systems.

**Context**

Preparing for installation of components and systems includes ensuring the base is properly located and secure, level and ready to receive the machinery. Preparing for maintenance includes locking out equipment, and organizing parts, tools and personnel. The preparation must be done properly to ensure that the installation and maintenance can be done safely and efficiently.

---

**Sub-task**
**6.01** **Prepares for installation of components and systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 6.01.01 | knowledge of machinery specifications such as weight, dimensions, tolerances and capacities |
| 6.01.02 | knowledge of accessibility requirements of equipment |
| 6.01.03 | knowledge of types of bases such as cast, sole plates, fabricated and skid mounted |
| 6.01.04 | knowledge of base components such as anchor bolts, jacking bolts and shims |
| 6.01.05 | knowledge of foundation construction considerations such as concrete cure times, placement of anchor bolts and load capabilities |
| 6.01.06 | ability to select and organize required parts, tools and equipment |
| 6.01.07 | ability to read print information such as reference lines, datum points, elevations and benchmarks |
| 6.01.08 | ability to lay out location lines |
| 6.01.09 | ability to position and install anchor bolts |
| 6.01.10 | ability to level base |
| 6.01.11 | ability to grout base |

**Sub-task**

**6.02** **Prepares for maintenance of components and systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 6.02.01 | knowledge of manufacturers' specifications of machinery to be maintained |
| 6.02.02 | ability to communicate and co-ordinate maintenance activities and schedules with other personnel |
| 6.02.03 | ability to shutdown, lock out and disconnect components |
| 6.02.04 | ability to clean work area |
| 6.02.05 | ability to obtain required permits |
| 6.02.06 | ability to interpret, organize and log maintenance history data of components and systems |
| 6.02.07 | ability to select and organize required parts, tools and equipment |

# BLOCK B RIGGING, HOISTING AND LIFTING

**Trends**

Workers are displaying more awareness and placing more emphasis on safe rigging, hoisting and lifting practices. Equipment is becoming more mobile and versatile.

**Related Components**

All components apply.

**Tools and Equipment**

Access, rigging, hoisting and lifting equipment, hand tools.

## Task 7 Plans lift.

**Context**

Industrial mechanics (millwrights) determine load and select appropriate rigging, hoisting and lifting equipment to ensure proper and safe lifts of machinery.

**Sub-task 7.01** **Determines load.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 7.01.01 | knowledge of safety regulations and safe rigging, hoisting and lifting practices |
| 7.01.02 | knowledge of weight, size/dimensions of working load and centre of gravity principles |
| 7.01.03 | knowledge of requirements for engineered lifts |
| 7.01.04 | ability to calculate and determine load weight |

**Sub-task**
**7.02** **Selects rigging equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 7.02.01 | knowledge of rigging equipment such as chains, wire ropes, nylon slings, eyebolts, hoist rings, hooks and shackles |
| 7.02.02 | knowledge of limitations of rigging equipment |
| 7.02.03 | knowledge of safety regulations such as safety factors and safe working loads |
| 7.02.04 | knowledge of fibre ropes, knots and hitches |
| 7.02.05 | ability to select components such as shackles, spreader bars and softeners |
| 7.02.06 | ability to apply jurisdictional codes when using equipment |
| 7.02.07 | ability to assess and inspect rigging equipment condition |

**Sub-task**
**7.03** **Selects lifting equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 7.03.01 | knowledge of lifting equipment such as overhead crane, mobile crane, forklift truck, hydraulic hoist, gantries, jacks, chainfalls, snatch blocks, block & tackles, tuggers, hand winches and come-alongs |
| 7.03.02 | knowledge of limitations of lifting equipment |
| 7.03.03 | knowledge of safety regulations such as safety factors and safe working loads |
| 7.03.04 | ability to assess and inspect lifting equipment condition |

## Task 8 — Hoists load.

**Context**

Hoisting heavy loads is a hazardous activity and care must be taken to ensure the safety of all personnel and prevent damage to equipment. Industrial mechanics (millwrights) should be skilled in the proper procedures for hoisting and lifting loads.

---

**Sub-task 8.01** — **Secures lift area.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 8.01.01 | knowledge of safety practices |
| 8.01.02 | ability to assess site and environmental conditions |
| 8.01.03 | ability to determine and secure lift radius using barricades and tape |

---

**Sub-task 8.02** — **Sets up rigging, hoisting and lifting equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 8.02.01 | ability to install all rigging, hoisting and lifting components in preparation for use |
| 8.02.02 | ability to prepare lift equipment and sites |
| 8.02.03 | ability to read and interpret load charts |
| 8.02.04 | ability to perform a safety audit of all rigging, hoisting and lifting equipment |
| 8.02.05 | ability to adjust to environmental conditions such as wind, shifting ground, rain and snow |

**Sub-task**
**8.03** **Performs lift.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 8.03.01 | knowledge of safe lifting procedures |
| 8.03.02 | knowledge of applicable regulations regarding safe lifting practices |
| 8.03.03 | ability to direct crane operator using hand signals and radio signals |
| 8.03.04 | ability to assess and make adjustments to stabilize load as required |

## Task 9 — Inspects and maintains rigging, hoisting and lifting equipment.

**Context** Proper inspection, maintenance and storage of rigging, hoisting and lifting equipment are essential to ensure the safety of all personnel and prevent damage to equipment.

**Sub-task**
**9.01** **Conducts pre-lift and post-lift equipment inspection.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 9.01.01 | knowledge of regulations and procedures governing the use of rigging, hoisting and lifting equipment |
| 9.01.02 | ability to assess and detect faulty or damaged equipment |
| 9.01.03 | ability to tag and report faulty or damaged equipment |
| 9.01.04 | ability to identify non-repairable equipment and remove from service |

**Sub-task**

**9.02** **Maintains rigging, hoisting and lifting equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 9.02.01 | knowledge of regulations and procedures governing the use of rigging, hoisting and lifting equipment |
| 9.02.02 | knowledge of equipment and their restrictions |
| 9.02.03 | ability to perform scheduled maintenance on equipment such as lubricating and cleaning |
| 9.02.04 | ability to perform safety audit of rigging, hoisting and lifting equipment |
| 9.02.05 | ability to identify and replace damaged hardware such as eyebolts, slings, shackles and hooks |

**Sub-task**

**9.03** **Stores equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 9.03.01 | knowledge of recommended environmental conditions for storing rigging, hoisting and lifting equipment |
| 9.03.02 | knowledge of storing methods for equipment such as wire ropes, chains, slings, chain blocks and grip hoist |
| 9.03.03 | ability to identify and replace damaged equipment prior to storage |

# BLOCK C MECHANICAL COMPONENTS AND SYSTEMS

**Trends**

Machinery analysis is increasingly being performed by some industrial mechanics (millwrights) using complex monitoring systems. Laser alignment equipment is becoming more common. The maintenance of machinery has been made easier through new technology in tools and components.

**Related Components**

Prime movers, bearings, couplings, guards, rails, lubrication systems, cooling systems, fasteners, bases, shafts, seals, housings, cams, cam locks, followers, clutches, brakes, fluid drives, hydraulic and pneumatic controls, gears, chains, belts, sprockets, sheaves, pulleys, hubs, taper locks, collars, friction pads, diaphragms, springs, packings, casings.

**Tools and Equipment**

See Appendix A.

## Task 10 Services prime movers.

**Context**

Servicing includes installing, diagnosing, repairing and maintaining. Prime movers are the heart of the mechanical system and include equipment such as electric motors, gas and steam turbines, internal combustion engines, and positive displacement pumps. They must be installed correctly and maintained properly to provide optimum power and torque to the driven systems and to ensure longevity of the prime mover.

**Sub-task**
**10.01** **Installs prime movers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 10.01.01 | knowledge of types of prime movers such as electric motors, gas and steam turbines, internal combustion engines and positive displacement pumps |
| 10.01.02 | knowledge of components such as couplings, sheaves, cams, followers and gear boxes |
| 10.01.03 | knowledge of manufacturers' or job site specifications |
| 10.01.04 | knowledge of auxiliary systems such as lubrication and cooling |
| 10.01.05 | knowledge of sequence of installation |
| 10.01.06 | ability to use installation tools such as torque wrenches, dial indicators, precision levels and optical or laser alignment equipment |
| 10.01.07 | ability to secure, level and align prime mover with driven equipment to required specifications |
| 10.01.08 | ability to connect prime mover to driven equipment with components such as couplings, sheaves, sprockets and gear boxes |
| 10.01.09 | ability to install auxiliary systems |
| 10.01.10 | ability to install safety guards according to industry specifications and standards |

**Sub-task**
**10.02** **Diagnoses prime movers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 10.02.01 | knowledge of operating principles |
| 10.02.02 | knowledge of components such as couplings, sheaves, cams, followers and gear boxes |
| 10.02.03 | knowledge of common faults such as loss of rpm and the failure of bearings, seals and lubrication systems |
| 10.02.04 | knowledge of diagnostic procedures for various prime movers |

| | |
|---|---|
| 10.02.05 | ability to use test/evaluation procedures and specialized equipment |
| 10.02.06 | ability to perform sensory inspection of prime movers |
| 10.02.07 | ability to troubleshoot and identify faults with prime movers and auxiliary systems |

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**Sub-task**
**10.03** **Repairs prime movers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 10.03.01 | knowledge of hazards such as flammable liquids, steam and electrical shock |
| 10.03.02 | knowledge of components such as bearings, shafts, cams, followers, cranks, valves and vanes |
| 10.03.03 | knowledge of installation procedures of components |
| 10.03.04 | ability to dismantle and reassemble prime movers to specifications using match (witness) marks |
| 10.03.05 | ability to rebuild and replace components to manufacturers' specifications |
| 10.03.06 | ability to use precision measuring tools such as micrometers, torque wrenches and vernier calipers |

---

**Sub-task**
**10.04** **Maintains prime movers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 10.04.01 | knowledge of machinery specifications such as fluid levels, temperatures and pressures |
| 10.04.02 | knowledge of components such as bearings, shafts, cams, followers, cranks, pistons, valves and vanes |
| 10.04.03 | ability to check and adjust components such as packings, governor controls and overspeed trips |
| 10.04.04 | ability to check and adjust coolant levels and supply |

## Task 11 Services shafts, bearings and seals.

**Context**

Shafts transmit power and torque from the prime mover to the driven equipment. Bearings maintain the shaft centerline and allow rotary or linear shaft movement with minimal friction. Seals prevent contamination of other components and ensure lubrication containment. Servicing includes installing, diagnosing, repairing and maintaining these components.

---

**Sub-task**

**11.01 Installs shafts, bearings and seals.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 11.01.01 | knowledge of types of shafts such as drive, counter, jack and hollow |
| 11.01.02 | knowledge of types of friction and anti-friction (rolling element-type) bearings |
| 11.01.03 | knowledge of anti-friction (rolling element-type) bearing installation and removal components and tools such as taper locks, cam locks and pullers |
| 11.01.04 | knowledge of bearing materials such as new alloys and advanced plastics |
| 11.01.05 | knowledge of types of bearing housings such as pillow blocks, split and flange |
| 11.01.06 | knowledge of types of bearing fits such as press, slide and interference |
| 11.01.07 | knowledge of lubrication requirements |
| 11.01.08 | knowledge of types of seals such as static, dynamic, mechanical, contact and non-contact |
| 11.01.09 | ability to select shafts, bearings and seals according to specifications such as medium, loads, temperatures, pressures and rpm |
| 11.01.10 | ability to install friction bearings using equipment such as arbor presses and scrapers |
| 11.01.11 | ability to install anti-friction (rolling element-type) bearings using equipment such as induction heaters, oil baths, arbor presses and bearing ovens |
| 11.01.12 | ability to check clearances of bearings and seals |
| 11.01.13 | ability to install fixed and floating bearing arrangements |
| 11.01.14 | ability to align shafts and bearings to manufacturers' specifications |
| 11.01.15 | ability to apply shaft lubricants and adhesives |

| | |
|---|---|
| 11.01.16 | ability to set pre-load to manufacturers' specifications |
| 11.01.17 | ability to install safety guards according to industry specifications and standards |

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**Sub-task**
**11.02** **Diagnoses shafts, bearings and seals.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 11.02.01 | knowledge of bearing faults such as loss of clearance, overheating excessive lubrication and lack of lubrication |
| 11.02.02 | knowledge of shaft faults such as bent and worn shafts |
| 11.02.03 | knowledge of seal materials compatible with certain liquids |
| 11.02.04 | knowledge of seal faults such as leaking, deterioration and improper installation |
| 11.02.05 | knowledge of initial, installed and running bearing clearances |
| 11.02.06 | ability to use test/evaluation procedures and specialized equipment |
| 11.02.07 | ability to perform sensory inspections of shafts, bearings and seals |
| 11.02.08 | ability to monitor temperature of bearings |
| 11.02.09 | ability to measure clearances in friction and anti-friction (rolling element-type) bearings |

---

**Sub-task**
**11.03** **Repairs shafts, bearings and seals.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 11.03.01 | knowledge of bearing fits and tolerances |
| 11.03.02 | knowledge of manufacturers' specifications |
| 11.03.03 | knowledge of lubrication requirements |
| 11.03.04 | knowledge of shaft restoration applications such as shaft straightening, spray welding, knurling and using sleeves |

| | |
|---|---|
| 11.03.05 | ability to access shafts, bearings and seals by removing components such as housings, sleeves, snap rings, collars and covers |
| 11.03.06 | ability to remove and replace shafts, bearings and seals |
| 11.03.07 | ability to check alignment of shafts and bearings |
| 11.03.08 | ability to size and replace o-rings |
| 11.03.09 | ability to pour and scrape new friction bearings |
| 11.03.10 | ability to remove burrs and nicks |
| 11.03.11 | ability to machine keyway and key seats |

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**Sub-task**

**11.04 Maintains shafts, bearings and seals.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 11.04.01 | knowledge of temperature monitoring equipment such as temperature probes and thermographic equipment |
| 11.04.02 | ability to monitor automatic bearing and seal lubrication systems |
| 11.04.03 | ability to monitor temperature, vibration and pressure |
| 11.04.04 | ability to adjust packings |
| 11.04.05 | ability to adjust flow and pressure controls for cooling and lubrication of sealing systems |

## Task 12 Services couplings, clutches and brakes.

**Context** Couplings transfer rotary motion from one shaft to another. Clutches allow engagement and disengagement of power and torque and brakes slow or stop the motion.

### Sub-task 12.01 Installs couplings, clutches and brakes.

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 12.01.01 | knowledge of types of couplings such as rigid, flexible, fluid and electromagnetic |
| 12.01.02 | knowledge of types of clutches such as overrunning, friction, positive contact and fluid |
| 12.01.03 | knowledge of types of brakes such as friction, fluid and electromagnetic |
| 12.01.04 | knowledge of types of fasteners/retainers such as keys, taper locks, dowels and set screws |
| 12.01.05 | knowledge of required clearances for couplings, clutches and brakes |
| 12.01.06 | ability to use fastening and installation tools such as arbor presses and hydraulic presses |
| 12.01.07 | ability to select couplings, clutches and brakes taking into consideration requirements such as rpm, horsepower, torque and working conditions |
| 12.01.08 | ability to establish coupling to shaft fits using inside and outside micrometers |
| 12.01.09 | ability to install couplings, clutches and brakes to specified clearances |
| 12.01.10 | ability to align couplings, clutches and brakes |
| 12.01.11 | ability to install safety guards according to industry specifications and standards |

**Sub-task**
**12.02** **Diagnoses couplings, clutches and brakes.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 12.02.01 | knowledge of coupling faults such as excessive vibration and worn components |
| 12.02.02 | knowledge of clutch and brake faults such as wear, overheating, excessive vibration and slippage |
| 12.02.03 | knowledge of running clearances and tolerances |
| 12.02.04 | ability to use test/evaluation procedures and specialized equipment |
| 12.02.05 | ability to perform sensory inspections to couplings, clutches and brakes |
| 12.02.06 | ability to monitor temperature of couplings, clutches and brakes |

**Sub-task**
**12.03** **Repairs couplings, clutches and brakes.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 12.03.01 | knowledge of components of couplings, clutches and brakes |
| 12.03.02 | knowledge of setup and operation of couplings, clutches and brakes |
| 12.03.03 | knowledge of indications of component failure such as clutch and brake slippage, excessive heat and vibration |
| 12.03.04 | ability to replace coupling components such as springs, grids and elastomeric elements |
| 12.03.05 | ability to replace clutch and brake components such as friction pads, diaphragms and springs |
| 12.03.06 | ability to use installation tools such as arbor presses, hydraulic presses and pullers |
| 12.03.07 | ability to adjust clutches and brakes |

**Sub-task**
**12.04** **Maintains couplings, clutches and brakes.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 12.04.01 | knowledge of types of couplings such as rigid, flexible and fluid |
| 12.04.02 | knowledge of types of clutches such as overrunning, friction, positive contact and fluid |
| 12.04.03 | knowledge of types of brakes such as friction, fluid and electromagnetic |
| 12.04.04 | knowledge of components of couplings, clutches and brakes |
| 12.04.05 | ability to monitor temperature, vibration and pressure |
| 12.04.06 | ability to measure and adjust clutch and brake clearances |
| 12.04.07 | ability to monitor and adjust level of fluid or shot |

## Task 13 Services chain and belt drive systems.

**Context** Chain and belt drive systems may be a component of a larger power transmission system. They transmit power from one shaft to another and may be used to increase or reduce speed or torque. Proper installation, alignment and maintenance are key to increasing the operating life of the system.

**Sub-task**
**13.01** **Installs chain and belt drive systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 13.01.01 | knowledge of types of chains such as roller, silent, pintle and detachable |
| 13.01.02 | knowledge of types of belts such as v-belts, timing belts and flat belts |
| 13.01.03 | knowledge of belt and chain sizing |
| 13.01.04 | knowledge of chain components such as sprockets, idlers and links |

| | |
|---|---|
| 13.01.05 | knowledge of belt drive components such as sheaves, idlers and pulleys |
| 13.01.06 | knowledge of load capacities |
| 13.01.07 | knowledge of idler positioning to accommodate arc of contact, tension and slack |
| 13.01.08 | ability to select chains and belts to match sprockets and sheaves |
| 13.01.09 | ability to calculate belt and chain lengths for installation and wear |
| 13.01.10 | ability to calculate speed and torque ratios |
| 13.01.11 | ability to use installation tools such as chain breaker, chain puller and hand tools |
| 13.01.12 | ability to align sprockets and sheaves |
| 13.01.13 | ability to adjust chain and belt tension |
| 13.01.14 | ability to install safety guards according to industry specifications and standards |

---

**Sub-task**

**13.02** **Diagnoses chain and belt drive systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 13.02.01 | knowledge of chain and belt faults such as belt slippage and excessive wear |
| 13.02.02 | knowledge of indications of faults such as noise, vibration and excessive heat |
| 13.02.03 | ability to remove guarding |
| 13.02.04 | ability to use test/evaluation procedures and specialized equipment |
| 13.02.05 | ability to perform sensory inspection |
| 13.02.06 | ability to measure belt and chain tension |
| 13.02.07 | ability to measure belt and chain wear |
| 13.02.08 | ability to measure sheave and sprocket wear |

**Sub-task**
**13.03** **Repairs chain and belt drive systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 13.03.01 | knowledge of chain and belt drive system components |
| 13.03.02 | knowledge of belt and chain sizing |
| 13.03.03 | ability to replace chains and chain components such as links, sprockets and idlers |
| 13.03.04 | ability to replace belts and belt components such as sheaves and pulleys |
| 13.03.05 | ability to realign sprockets and sheaves |
| 13.03.06 | ability to use fastening and installation tools such as arbor presses, chain breakers, hydraulic presses and pullers |
| 13.03.07 | ability to modify safety guards as required by industry specifications and standards |

**Sub-task**
**13.04** **Maintains chain and belt drive systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 13.04.01 | knowledge of manufacturers' specifications such as tension, rpm, capacity limitations and operating conditions |
| 13.04.02 | ability to adjust chain and belt tension |
| 13.04.03 | ability to clean and inspect chains and belts |
| 13.04.04 | ability to check alignment of sprockets and sheaves |
| 13.04.05 | ability to lubricate chains |

## Task 14 — Services gear systems.

**Context**

Gear systems transmit power from one shaft to another and may be used to increase or reduce speed or torque. Gear systems are used when there is a need for greater versatility such as speed control, shaft orientation and timing requirements.

---

**Sub-task**
**14.01** **Installs gear systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 14.01.01 | knowledge of types of gear systems such as planetary, reduction and worm drives |
| 14.01.02 | knowledge of types of gears such as spur, herringbone and hypoid |
| 14.01.03 | knowledge of gear terminology such as pitch diameter, diametral pitch, dedendum, addendum and working depth |
| 14.01.04 | knowledge of gear system components such as shafts, bearings and casings |
| 14.01.05 | knowledge of simple and compound gear trains |
| 14.01.06 | knowledge of installation methods such as pressed, keyed, sliding and pinned |
| 14.01.07 | ability to perform gear calculations |
| 14.01.08 | ability to select gears for application |
| 14.01.09 | ability to follow installation sequence |
| 14.01.10 | ability to use installation tools such as arbor presses, hydraulic presses and hand tools |
| 14.01.11 | ability to check clearances, tooth contact and backlash |
| 14.01.12 | ability to level, align and secure gear box |
| 14.01.13 | ability to install safety guards according to industry specifications and standards |

**Sub-task**
**14.02** **Diagnoses gear systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 14.02.01 | knowledge of gear faults such as overheating, vibration and excessive noise |
| 14.02.02 | knowledge of lubrication methods such as splash, forced and oil rings |
| 14.02.03 | ability to monitor gear box temperature |
| 14.02.04 | ability to use test/evaluation procedures and specialized equipment |
| 14.02.05 | ability to perform sensory inspection |
| 14.02.06 | ability to check lubrication level and condition |

**Sub-task**
**14.03** **Repairs gear systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 14.03.01 | knowledge of gear system components and their installation requirements such as fits, thrust, clearances and tolerances |
| 14.03.02 | ability to use installation tools such as arbor presses, hydraulic presses and pullers |
| 14.03.03 | ability to gain access to gear systems |
| 14.03.04 | ability to identify components in need of replacement |
| 14.03.05 | ability to replace components such as gears, shafts, keys, bearings and seals |

**Sub-task**

**14.04** **Maintains gear systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 14.04.01 | knowledge of temperature monitoring equipment such as temperature probe and thermographic equipment |
| 14.04.02 | ability to monitor temperature and vibration |
| 14.04.03 | ability to monitor lubrication systems |
| 14.04.04 | ability to inspect and clean gear systems |
| 14.04.05 | ability to adjust clearances and backlash |

# BLOCK D MATERIAL HANDLING / PROCESS SYSTEMS

**Trends**

Regular maintenance of this equipment now includes condition monitoring and balancing. There has been an increase in the use of more sophisticated diagnostic equipment such as infrared, vibration analysis and ultrasonic/acoustic equipment. Electronic control systems have become more advanced.

**Related Components**

**Fans and Blowers:** impellers, rotors, lobes, sheaves, bearings, shafts, seals, bearing housings, fixing rings, gears, couplings, belts, louvers, safety guards.

**Compressors:** screws, check valves, pressure relief valves, pressure regulators, air dryers, sheaves, bearings, shafts, seals, gears, couplings, belts, safety guards.

**Pumps:** impellers, sheaves, bearings, shafts, seals, packings, shim packs, lantern rings, mechanical seals, wear rings, couplings, belts, face plates, safety guards.

**Conveying Systems:** couplings, pulleys, clutches, rollers, bearings, sheaves, backstops, sprockets, chains, belts, buckets, screws, piping, gear boxes, drive systems, trippers, ploughs, chutes, screens, skirt boards, filters, safety guards.

**Process Tanks and Containers:** agitators, filters, mechanical seals, packings, level and temperature indicators, pumps, valves, liners, venting systems.

**Tools and Equipment**

See Appendix A.

## Task 15 Services fans and blowers.

**Context** Fans and blowers are used to move materials such as exhaust, air and media. This task includes installation, diagnosis, repair and maintenance of fans and blowers. Proper and safe servicing practices ensure machine reliability and efficiency.

---

**Sub-task**
**15.01** **Installs fans and blowers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 15.01.01 | knowledge of types of fan systems such as induction, balanced and forced draft |
| 15.01.02 | knowledge of types of fans such as centrifugal and axial flow fans |
| 15.01.03 | knowledge of types of blowers such as radial and axial |
| 15.01.04 | knowledge of fan and blower specifications such as cubic feet per minute (CFM), horsepower, speeds, clearances and volumes |
| 15.01.05 | knowledge of material to be moved |
| 15.01.06 | knowledge of couplings, belts and sheaves |
| 15.01.07 | ability to secure, level and align fans and blowers |
| 15.01.08 | ability to use installation tools such as dial indicators, precision levels and optical or laser alignment equipment |
| 15.01.09 | ability to connect fans and blowers to driver through couplings, sheaves and belts |
| 15.01.10 | ability to install safety guards according to industry specifications and standards |

**Sub-task**
**15.02** **Diagnoses fans and blowers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 15.02.01 | knowledge of fan and blower faults such as unbalance, improper lubrication and bearing failure |
| 15.02.02 | knowledge of fan and blower specifications such as CFM, horsepower, speeds, volumes and clearances |
| 15.02.03 | ability to perform sensory inspection of components such as sheaves, louvers, bearings, belts and fan blades |
| 15.02.04 | ability to use test/evaluation procedures and specialized equipment |
| 15.02.05 | ability to recognize conditions that lead to failure or breakdown of fans and blowers |

**Sub-task**
**15.03** **Repairs fans and blowers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 15.03.01 | knowledge of types of fans such as centrifugal and axial flow fans |
| 15.03.02 | knowledge of types of blowers such as radial and axial |
| 15.03.03 | knowledge of fan and blower specifications such as CFM, horsepower, speeds, volumes and clearances |
| 15.03.04 | ability to correct unbalances |
| 15.03.05 | ability to replace defective fan and blower components |
| 15.03.06 | ability to use repair tools and equipment |

**Sub-task**
**15.04** **Maintains fans and blowers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 15.04.01 | knowledge of types of fans such as centrifugal and axial flow fans |
| 15.04.02 | knowledge of types of blowers such as radial and axial |
| 15.04.03 | knowledge of manufacturers' specifications |
| 15.04.04 | ability to clean fan blades |
| 15.04.05 | ability to maintain drive components |
| 15.04.06 | ability to lock out and isolate fans for servicing |

## Task 16 Services compressors.

**Context**

Compressors are the source which supplies and controls pressurized air systems. Compressors are also used in the gas and oil industry. They are also used as a power source for pneumatic tools and equipment.

This task includes installation, diagnosis, repair and maintenance of compressors. Proper and safe servicing practices ensure machine reliability and efficiency.

**Sub-task**
**16.01** **Installs compressors.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 16.01.01 | knowledge of types of compressors such as radial, reciprocating and screw |
| 16.01.02 | knowledge of compressor applications such as supply air, gas supply and process control |
| 16.01.03 | knowledge of compressor specifications such as CFM, horsepower, pressure and volumes |

| | |
|---|---|
| 16.01.04 | knowledge of components such as air dryers, filters, regulators, lubricators, pressure relief valves, intercoolers and aftercoolers |
| 16.01.05 | knowledge of drive components such as couplings and belts |
| 16.01.06 | ability to secure, level and align compressors |
| 16.01.07 | ability to use installation tools such as levelling and alignment equipment |
| 16.01.08 | ability to recognize and adhere to government standards regarding pressure vessels and piping |
| 16.01.09 | ability to install safety guards according to industry specifications and standards |

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**Sub-task**

**16.02 Diagnoses compressors.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 16.02.01 | knowledge of compressor faults such as lack of pressure, and excessive loading and unloading |
| 16.02.02 | knowledge of compressor specifications such as CFM, horsepower, pressure and volumes |
| 16.02.03 | knowledge of cooling and lubrication systems |
| 16.02.04 | ability to perform sensory inspection of components such as pressure relief valves, check valves and temperature gauges |
| 16.02.05 | ability to use test/evaluation procedures and specialized equipment |
| 16.02.06 | ability to recognize conditions that lead to failure or breakdown of compressors |

**Sub-task**
**16.03** **Repairs compressors.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 16.03.01 | knowledge of types of compressors such as radial, reciprocating and screw |
| 16.03.02 | knowledge of compressor specifications such as CFM, horsepower, pressure and volumes |
| 16.03.03 | ability to replace defective compressor components such as heads, cross heads, pistons, filters, valves, auto drains and temperature gauges |
| 16.03.04 | ability to use repair tools and equipment |
| 16.03.05 | ability to align prime mover to compressor |
| 16.03.06 | ability to lock out and isolate compressors |
| 16.03.07 | ability to drain moisture from compressors, receivers and coolers |

**Sub-task**
**16.04** **Maintains compressors.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 16.04.01 | knowledge of types of compressors such as radial, reciprocating and screw |
| 16.04.02 | knowledge of manufacturers' specifications |
| 16.04.03 | ability to clean and/or replace oil filters and air filters |
| 16.04.04 | ability to maintain cooling systems |
| 16.04.05 | ability to adjust loading and unloading set points |
| 16.04.06 | ability to drain moisture from compressors, coolers and receivers |
| 16.04.07 | ability to verify operation of relief valves, check valves and auto drain valves |
| 16.04.08 | ability to maintain drive components |

## Task 17 Services pumps.

**Context**

Pumps are used to move fluid and other media by positive or non-positive displacement. This task includes installation, diagnosis, repair and maintenance of pumps. Proper and safe servicing practices ensure machine reliability and efficiency.

---

**Sub-task**
**17.01 Installs pumps.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 17.01.01 | knowledge of types of pumps such as centrifugal, reciprocating and gear |
| 17.01.02 | knowledge of pump terminology such as static head, suction head and suction lift |
| 17.01.03 | knowledge of pump specifications such as pump curves, volumes, pressures and flow |
| 17.01.04 | knowledge of media being pumped |
| 17.01.05 | knowledge of components such as bearings, mechanical seals, impellers, sleeves, lantern rings and packings |
| 17.01.06 | knowledge of drive components such as couplings, sheaves and belts |
| 17.01.07 | knowledge of piping and tubing sizing and schematics |
| 17.01.08 | ability to select pump for specific applications |
| 17.01.09 | ability to set pump clearances |
| 17.01.10 | ability to install and adjust packings and seals |
| 17.01.11 | ability to secure, level and align pumps |
| 17.01.12 | ability to use installation tools such as torque wrenches, and levelling and alignment equipment |
| 17.01.13 | ability to install safety guards according to industry specifications and standards |

**Sub-task**
**17.02** **Diagnoses pumps.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 17.02.01 | knowledge of faults such as low flows, cavitation and insufficient pressures |
| 17.02.02 | knowledge of specifications such as pump clearances, pump head limits and pump curves |
| 17.02.03 | knowledge of cooling and lubrication systems |
| 17.02.04 | ability to perform sensory inspection of components such as seals, bearings and filters |
| 17.02.05 | ability to use recognized test/evaluation procedures and specialized equipment |
| 17.02.06 | ability to recognize conditions that lead to failure or breakdown of pumps |

**Sub-task**
**17.03** **Repairs pumps.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 17.03.01 | knowledge of types of pumps such as centrifugal, reciprocating and gear |
| 17.03.02 | knowledge of specifications such as pump clearances, impeller trim size, pump head limits and pump curves |
| 17.03.03 | ability to replace defective pump components such as bearings, seals, shafts, wear rings, impellers, sleeves, lantern rings and face plates |
| 17.03.04 | ability to balance components such as shafts, couplings and impellers |
| 17.03.05 | ability to use repair tools and equipment |
| 17.03.06 | ability to install and align prime mover to pump |

**Sub-task**
**17.04** **Maintains pumps.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 17.04.01 | knowledge of types of pumps such as centrifugal, reciprocating and gear |
| 17.04.02 | knowledge of manufacturers' specifications |
| 17.04.03 | ability to monitor vacuum, pressure and flow rates |
| 17.04.04 | ability to adjust packings and seals |
| 17.04.05 | ability to maintain clearances |
| 17.04.06 | ability to maintain drive components |

## Task 18 Services conveying systems.

**Context** Conveying systems are used to transfer products (usually solids) safely and efficiently. This task includes installation, diagnosis, repair and maintenance of conveying systems.

**Sub-task**
**18.01** **Installs conveying systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 18.01.01 | knowledge of types of mechanical conveying systems such as belt, chain, screw, roller and bucket |
| 18.01.02 | knowledge of conveying system accessories such as trippers, ploughs, chutes, screens and skirt boards |
| 18.01.03 | knowledge of types of pneumatic conveying systems such as low pressure and high pressure |
| 18.01.04 | knowledge of specifications such as speed, distance travelled and load weight |

| | |
|---|---|
| 18.01.05 | knowledge of material to be conveyed |
| 18.01.06 | knowledge of types of filters such as cyclones, bag shakers and precipitators |
| 18.01.07 | knowledge of conveyor components such as scrapers, bearings, sprockets, chains, belts and counter-weight assemblies |
| 18.01.08 | knowledge of types of pulleys and rollers such as crowned, tail, take-up, tracking and idler |
| 18.01.09 | ability to install conveyor components such as bearings, pulleys and rollers |
| 18.01.10 | ability to select conveying system for specific applications |
| 18.01.11 | ability to connect belts using splicing techniques such as vulcanizing, cold splicing and applying mechanical fasteners |
| 18.01.12 | ability to connect chains using components such as connecting links, rivets and locking clips |
| 18.01.13 | ability to secure, level and align conveying system |
| 18.01.14 | ability to use installation tools such as hand tools, and levelling and alignment equipment |
| 18.01.15 | ability to install safety guards according to industry specifications and standards |
| 18.01.16 | ability to install sensory devices such as motion detectors and depth sensors |

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**Sub-task**

**18.02 Diagnoses conveying systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 18.02.01 | knowledge of conveying system faults such as belt tracking, worn components and improper tension |
| 18.02.02 | knowledge of conveying system specifications such as speed, distance travelled and load weight |
| 18.02.03 | ability to perform sensory inspection of components such as couplings, pulleys, rollers, bearings, sheaves, sprockets, chains and belts |
| 18.02.04 | ability to perform sensory inspection of filters such as cyclones, bag shakers, screens and precipitators |
| 18.02.05 | ability to use test/evaluation procedures and specialized equipment |
| 18.02.06 | ability to recognize conditions that lead to failure or breakdown of conveying systems |

**Sub-task**
**18.03** **Repairs conveying systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 18.03.01 | knowledge of types of mechanical conveying systems such as belt, chain, screw, roller and bucket |
| 18.03.02 | knowledge of types of pneumatic conveying systems such as low pressure and high pressure |
| 18.03.03 | knowledge of conveying system specifications such as speed, distance travelled and load weight |
| 18.03.04 | knowledge of manufacturers' specifications |
| 18.03.05 | ability to replace defective conveying system components such as couplings, pulleys, rollers, bearings, sheaves, sprockets, screens, chains and belts |
| 18.03.06 | ability to connect belts using splicing techniques such as vulcanizing, cold splicing and applying mechanical fasteners |
| 18.03.07 | ability to connect chains using components such as connecting links, rivets and locking clips |
| 18.03.08 | ability to use repair tools and equipment |
| 18.03.09 | ability to install and align prime mover to conveyor system |

**Sub-task**
**18.04** **Maintains conveying systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 18.04.01 | knowledge of types of mechanical conveying systems such as belt, chain, screw, roller and bucket |
| 18.04.02 | knowledge of types of pneumatic conveying systems such as low pressure and high pressure |
| 18.04.03 | knowledge of conveying system specifications such as speed, distance travelled and load weight |
| 18.04.04 | knowledge of types of filters such as cyclones, bag shakers and precipitators |

| | |
|---|---|
| 18.04.05 | knowledge of manufacturers' specifications |
| 18.04.06 | ability to adjust tracking of mechanical conveying systems |
| 18.04.07 | ability to adjust conveying system accessories such as belt scraper, guides and training idlers |
| 18.04.08 | ability to maintain components such as couplings, pulleys, rollers, bearings, sheaves, sprockets, screens, chains and belts |
| 18.04.09 | ability to replace filters |

## Task 19 — Services process tanks and containers.

**Context**

Process tanks and containers are usually used to store and mix materials. Tanks and containers may be pressurized or open to atmosphere. This task includes installation, diagnosis, repair and maintenance of process tanks and containers such as bins and hoppers.

### Sub-task 19.01 — Installs process tanks and containers.

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | no | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 19.01.01 | knowledge of types of process tanks and containers such as pressurized vessels and storage tanks |
| 19.01.02 | knowledge of process tank and container specifications such as capacity and compatibility |
| 19.01.03 | knowledge of process tank and container components such as piping, agitators, vents, pumps, compressors, blowers and level indicators |
| 19.01.04 | knowledge of material to be held and holding requirements such as corrosion resistance, tank pressures and temperature |
| 19.01.05 | knowledge of piping schematics |
| 19.01.06 | knowledge of environmental containment systems |
| 19.01.07 | knowledge of hazards of and procedures for working in confined spaces |
| 19.01.08 | ability to secure, level and align process tanks and containers |

| | |
|---|---|
| 19.01.09 | ability to use installation tools such as layout and levelling tools |
| 19.01.10 | ability to install safety guards according to industry specifications and standards |

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**Sub-task**
**19.02** **Diagnoses process tanks and containers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | no | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 19.02.01 | knowledge of process tank and container faults such as leaks, and loss of or excess pressure |
| 19.02.02 | knowledge of process tank and container specifications such as capacity and compatibility |
| 19.02.03 | knowledge of material to be held and holding requirements such as corrosion resistance, tank pressures and temperature |
| 19.02.04 | knowledge of hazards of and procedures for working in confined spaces |
| 19.02.05 | ability to perform sensory inspection of components such as piping, agitators, vents, pumps and level indicators |
| 19.02.06 | ability to use test/evaluation procedures and specialized equipment |
| 19.02.07 | ability to recognize conditions that lead to failure or breakdown of process tanks and containers |

---

**Sub-task**
**19.03** **Repairs process tanks and containers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | no | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 19.03.01 | knowledge of types of process tanks and containers such as pressurized vessels and storage tanks |
| 19.03.02 | knowledge of process tank and container specifications such as capacity and compatibility |
| 19.03.03 | knowledge of regulations governing steam and pressure vessels |

| | |
|---|---|
| 19.03.04 | knowledge of material to be held and holding requirements such as corrosion resistance, tank pressures and temperature |
| 19.03.05 | knowledge of hazards of and procedures for working in confined spaces |
| 19.03.06 | ability to replace defective components such as piping, agitators, vents, liners, pumps and level indicators |
| 19.03.07 | ability to use repair tools and equipment |
| 19.03.08 | ability to isolate and lock out equipment related to process tanks and containers |

---

**Sub-task**
**19.04** **Maintains process tanks and containers.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | no | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 19.04.01 | knowledge of types of process tanks and containers such as pressurized vessels and storage tanks |
| 19.04.02 | knowledge of process tank and container specifications such as capacity and compatibility |
| 19.04.03 | knowledge of hazards of and procedures for working in confined spaces |
| 19.04.04 | knowledge of cleaning requirements |
| 19.04.05 | ability to adjust process tank and container components |
| 19.04.06 | ability to change liners |
| 19.04.07 | ability to maintain ventilation systems |

**Trends**

Systems and components are more compact and more complex. Fluid power systems are continually evolving to operate faster and with greater power and efficiencies; it is critical that industrial mechanics (millwrights) stay abreast of new technologies.

**Related Components**

Pumps, compressors, valves, actuators, tanks, reservoirs, receivers, filters, piping, tubing, hoses, dryers, regulators, fluids, coolers, heaters, accumulators, intensifiers, strainers, seals, motors, cylinders.

**Tools and Equipment**

See Appendix A.

## Task 20 Services hydraulic systems.

**Context**

Hydraulic systems are versatile systems that use high pressure fluids to transmit power in a variety of industries. Industrial mechanics (millwrights) service these systems to ensure proper and efficient operation.

**Sub-task 20.01** **Installs hydraulic systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 20.01.01 | knowledge of types of hydraulic circuits such as sequence, pressure reducing and counter-balance |
| 20.01.02 | knowledge of hydraulic systems and components |
| 20.01.03 | knowledge of auxiliary components such as coolers, heaters and accumulators |
| 20.01.04 | knowledge of hydraulic principles |
| 20.01.05 | knowledge of viscosity of fluids |

| | |
|---|---|
| 20.01.06 | knowledge of installation procedures for hydraulic systems and components |
| 20.01.07 | ability to interpret schematic diagrams |
| 20.01.08 | ability to select hydraulic fluids to meet requirements |
| 20.01.09 | ability to select system components from schematics and specifications |
| 20.01.10 | ability to select and install reservoirs for hydraulic systems |
| 20.01.11 | ability to install and align hydraulic pumps and motors |
| 20.01.12 | ability to install components such as filters, strainers, hydraulic valves, actuators and motors |
| 20.01.13 | ability to measure, cut, bend and install piping, hoses and tubing |

---

**Sub-task**
**20.02** **Diagnoses hydraulic systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 20.02.01 | knowledge of hydraulic system faults such as loss of pressure, cavitations, aeration, leaks, loss of movement and speed, and overheating |
| 20.02.02 | knowledge of basic electrical principles |
| 20.02.03 | knowledge of hydraulic principles |
| 20.02.04 | knowledge of trade calculations and theories such as Bernoulli's principle and Pascal's law |
| 20.02.05 | knowledge of hydraulic system components such as pumps, control valves and actuators |
| 20.02.06 | knowledge of types of valves such as directional control, flow control and pressure control |
| 20.02.07 | ability to perform sensory inspection |
| 20.02.08 | ability to use test/evaluation procedures and specialized equipment |
| 20.02.09 | ability to interpret specifications from technical manuals |
| 20.02.10 | ability to check fluid levels and condition |
| 20.02.11 | ability to inspect hydraulic systems to identify faults |
| 20.02.12 | ability to identify components that require repair or replacement |
| 20.02.13 | ability to interpret hydraulic symbols and schematics |
| 20.02.14 | ability to record hydraulic data |

**Sub-task**
**20.03** **Repairs hydraulic systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 20.03.01 | knowledge of types of hydraulic circuits such as sequence, pressure reducing and counter-balance |
| 20.03.02 | knowledge of hydraulic system faults such as leaks, valve failure and contamination of fluid |
| 20.03.03 | knowledge of hazards and isolating procedures associated with high pressure fluids and stored energy |
| 20.03.04 | ability to release pressure to ensure system or system component is in a zero energy state |
| 20.03.05 | ability to repair and replace components such as actuators, pumps, filters and valves |
| 20.03.06 | ability to remove and replace component parts such as seals, pistons and valve spools |
| 20.03.07 | ability to bleed air from system |
| 20.03.08 | ability to test system operation prior to commissioning |
| 20.03.09 | ability to modify system to accommodate a change in requirements |
| 20.03.10 | ability to fine tune system pressure and fluid flow |

**Sub-task**
**20.04** **Maintains hydraulic systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 20.04.01 | knowledge of operation of primary components such as actuators, pumps and valves |
| 20.04.02 | knowledge of basic electrical principles |
| 20.04.03 | knowledge of hydraulic principles |
| 20.04.04 | knowledge of fluid conductors such as hoses, piping and tubing |

| | |
|---|---|
| 20.04.05 | knowledge of types of fluids such as petroleum-based, fire resistant and synthetic |
| 20.04.06 | knowledge of system operating parameters such as temperature, pressure and flow |
| 20.04.07 | knowledge of filters, strainers and related contamination control equipment |
| 20.04.08 | ability to release pressure to a zero energy state |
| 20.04.09 | ability to check and adjust fluid levels |
| 20.04.10 | ability to check and adjust system pressure, temperature and flow |
| 20.04.11 | ability to check filters |
| 20.04.12 | ability to identify and locate system components |

## Task 21 — Services pneumatic and vacuum systems.

**Context**

Pneumatic and vacuum systems provide control and power for mechanical and process systems. Industrial mechanics (millwrights) are responsible for the installation, diagnosis, repair and maintenance of these systems.

### Sub-task 21.01 — Installs pneumatic and vacuum systems.

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 21.01.01 | knowledge of types of pneumatic circuits such as sequence and pressure reducing |
| 21.01.02 | knowledge of operation of vacuum systems |
| 21.01.03 | knowledge of types of pneumatic valves such as time delay, quick exhaust, directional control valves and regulators |
| 21.01.04 | knowledge of pneumatic and vacuum principles |
| 21.01.05 | knowledge of basic electrical principles |
| 21.01.06 | knowledge of installation procedures for all types of pneumatic and vacuum systems and components |
| 21.01.07 | ability to interpret schematic diagrams |

| | |
|---|---|
| 21.01.08 | ability to select and install pneumatic and vacuum system components from schematics and specifications |
| 21.01.09 | ability to select and install dryers, coolers and receivers for pneumatic and vacuum systems |
| 21.01.10 | ability to select and install system components such as filters, valves and actuators |
| 21.01.11 | ability to select, measure, cut, bend and install piping, hoses and tubing |

---

**Sub-task**

**21.02 Diagnoses pneumatic and vacuum systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 21.02.01 | knowledge of pneumatic system faults such as leaks, loss of movement and speed, and overheating |
| 21.02.02 | knowledge of vacuum system faults such as loss of vacuum pressure, overheating and leaks |
| 21.02.03 | knowledge of pneumatic and vacuum principles |
| 21.02.04 | knowledge of basic electrical principles |
| 21.02.05 | knowledge of trade calculations and theories such as Bernoulli's principle and Boyle's law |
| 21.02.06 | knowledge of pneumatic system components such as compressors, control valves and actuators |
| 21.02.07 | knowledge of vacuum system components such as vacuum pumps, valves and filters |
| 21.02.08 | ability to perform sensory inspections |
| 21.02.09 | ability to use test/evaluation procedures and specialized equipment |
| 21.02.10 | ability to interpret specifications from technical manuals |
| 21.02.11 | ability to identify components that require repair or replacement |
| 21.02.12 | ability to inspect pneumatic and vacuum systems to identify faults |
| 21.02.13 | ability to interpret pneumatic and vacuum symbols and schematics |
| 21.02.14 | ability to record pneumatic and vacuum data |

**Sub-task**
**21.03** **Repairs pneumatic and vacuum systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 21.03.01 | knowledge of types of pneumatic circuits such as sequence and pressure reducing |
| 21.03.02 | knowledge of operation of vacuum systems |
| 21.03.03 | knowledge of pneumatic and vacuum principles |
| 21.03.04 | knowledge of basic electrical principles |
| 21.03.05 | knowledge of hazards associated with high pressure air and stored energy |
| 21.03.06 | ability to release pressure to ensure system or system component is in a zero energy state |
| 21.03.07 | ability to repair and replace components such as receivers, dryers, regulators, lubricators, coolers, filters and valves |
| 21.03.08 | ability to remove and replace component parts such as seals, pistons and spools |
| 21.03.09 | ability to modify system to accommodate a change in requirements |
| 21.03.10 | ability to test system operation prior to commissioning |
| 21.03.11 | ability to fine tune system pressure and air flow |

**Sub-task**
**21.04** **Maintains pneumatic and vacuum systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 21.04.01 | knowledge of operation of primary components such as actuators, pumps, compressors and valves |
| 21.04.02 | knowledge of conductors such as hoses, piping and tubing |
| 21.04.03 | knowledge of pneumatic and vacuum principles |
| 21.04.04 | knowledge of basic electrical principles |
| 21.04.05 | knowledge of system operating parameters such as temperature, pressure and flow |

| | |
|---|---|
| 21.04.06 | knowledge of filters and related contamination control equipment |
| 21.04.07 | ability to identify and locate system components |
| 21.04.08 | ability to maintain inline lubrication systems |
| 21.04.09 | ability to check and adjust system pressure, temperature, cycling and flow |
| 21.04.10 | ability to check and change filters |

# BLOCK F

# PREVENTIVE AND PREDICTIVE MAINTENANCE, TESTING AND COMMISSIONING

**Trends**

Tools used for preventive and predictive maintenance and testing have advanced technologically in recent years. While only a small percentage of industrial mechanics (millwrights) currently use this equipment, the trade will need to be aware of these new technologies as they become more commonplace.

**Related Components**

All components apply.

**Tools and Equipment**

Measuring tools, testing equipment, hand tools, portable power tools, access equipment, PPE and safety equipment.

## Task 22 Performs preventive and predictive maintenance.

**Context**

Industrial mechanics (millwrights) may perform preventive and predictive maintenance tasks to optimize day-to-day machinery and equipment operation.

Preventive maintenance activities are based on periodic sampling and inspections. It involves the routine scheduling of maintenance activities. This schedule is based on past experience and manufacturers' recommendations.

Predictive maintenance activities utilize information from past and current performance records to objectively trend and predict mechanical faults. Predictive maintenance is a proactive monitoring approach rather than a time-based or reactive approach.

**Sub-task**
**22.01** **Performs preventive maintenance activities.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 22.01.01 | knowledge of production and maintenance policies |
| 22.01.02 | knowledge of preventive maintenance programs and schedules |
| 22.01.03 | knowledge of safe operating temperatures |
| 22.01.04 | ability to use preventive maintenance tools such as hand tools, temperature gauges and strobe lights |
| 22.01.05 | ability to perform preventive maintenance schedule activities such as inspecting components, fluid levels, guards and safety devices |
| 22.01.06 | ability to record information for future equipment evaluation |

**Sub-task**
**22.02** **Performs predictive maintenance activities.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 22.02.01 | knowledge of predictive maintenance requirements |
| 22.02.02 | knowledge of specialized predictive maintenance tools such as data collectors and computerized maintenance management systems |
| 22.02.03 | knowledge of maintenance history of equipment |
| 22.02.04 | ability to identify potential faults based on observations such as unusual sounds, vibrations, variations in fluid quality or level, and temperature changes |
| 22.02.05 | ability to use information from past and current data to predict mechanical faults |
| 22.02.06 | ability to record information for future equipment evaluation |

**Sub-task**
**22.03** **Performs machinery and equipment balancing.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | no | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 22.03.01 | knowledge of pre-balance procedures and requirements |
| 22.03.02 | knowledge of types of unbalance such as static, dynamic and coupled |
| 22.03.03 | knowledge of manufacturers' and company-specific specifications for balancing |
| 22.03.04 | knowledge of balancing machines and analyzing equipment |
| 22.03.05 | knowledge of static and dynamic balancing procedures |
| 22.03.06 | knowledge of single- and multi-plane balancing methods |
| 22.03.07 | ability to prepare machinery/equipment for balancing operation |
| 22.03.08 | ability to identify and correct unbalance in equipment and machinery |

## Task 23 Performs specialized testing and analysis.

**Context** Industrial mechanics (millwrights) may perform condition monitoring tests on rotating equipment. These may include vibration analysis, non-destructive testing (NDT) and fluid analysis. It is important to perform these tasks to ensure maximum life and reliability of the equipment.

**Sub-task**
**23.01** **Analyzes maintenance history of equipment.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | no | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 23.01.01 | knowledge of computerized maintenance management system |
| 23.01.02 | knowledge of preventive and predictive maintenance programs |

| | |
|---|---|
| 23.01.03 | knowledge of system and rotating equipment faults |
| 23.01.04 | ability to review and analyze collected data to determine suitable maintenance schedules |

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**Sub-task**
**23.02** **Tests machinery and equipment using vibration analysis procedures.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 23.02.01 | knowledge of vibration theory and characteristics |
| 23.02.02 | knowledge of types of analyzers and transducers and their applications |
| 23.02.03 | knowledge of data collection points |
| 23.02.04 | ability to select vibration analyzing equipment |
| 23.02.05 | ability to install the necessary manufacturer components to achieve consistent readings at predetermined access points |
| 23.02.06 | ability to collect readings at consistent points across rotating equipment |
| 23.02.07 | ability to identify vibration frequencies related to different machinery components |
| 23.02.08 | ability to recognize causes of vibration such as eccentricity, misalignment and shaft faults |

---

**Sub-task**
**23.03** **Analyzes vibration test data.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | no | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 23.03.01 | knowledge of vibration theory and characteristics |
| 23.03.02 | knowledge of types of analyzers and transducers and their applications |
| 23.03.03 | ability to download data from vibration analysis equipment to computer |
| 23.03.04 | ability to interpret and compare vibration data |

| | |
|---|---|
| 23.03.05 | ability to direct information for corrective action |
| 23.03.06 | ability to determine vibration limits through alarm thresholds |

---

**Sub-task**
**23.04** **Tests equipment and components using non-destructive testing (NDT).**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 23.04.01 | knowledge of NDT techniques such as dye penetrant, magnetic particle, radiography and ultrasonic |
| 23.04.02 | ability to select NDT method |
| 23.04.03 | ability to remove components for testing |
| 23.04.04 | ability to prepare machinery and components for NDT |

---

**Sub-task**
**23.05** **Analyzes NDT data.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 23.05.01 | knowledge of follow-up procedures |
| 23.05.02 | ability to record and interpret data |
| 23.05.03 | ability to detect faults such as cracks, thin walls and inclusions |
| 23.05.04 | ability to determine hardness of material |
| 23.05.05 | ability to direct information for corrective action |

**Sub-task**
**23.06** **Collects fluid samples.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 23.06.01 | knowledge of types of fluids to be tested such as oil, glycol and grease |
| 23.06.02 | knowledge of collection techniques |
| 23.06.03 | ability to recognize the equipment to be tested |
| 23.06.04 | ability to determine location to collect samples |
| 23.06.05 | ability to use sampling equipment such as test ports, vacuum pumps and containers |

**Sub-task**
**23.07** **Analyzes fluids and fluid test data.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 23.07.01 | knowledge of types of fluids to be tested such as oil, glycol and grease |
| 23.07.02 | knowledge of testing techniques such as particle count, filter patch, ferrography and viscosity |
| 23.07.03 | ability to interpret and compare fluid test data |
| 23.07.04 | ability to perform sensory inspection of fluid condition |
| 23.07.05 | ability to interpret external test report information such as contamination, abnormal viscosity and wear particles |
| 23.07.06 | ability to direct information for corrective action |

## Task 24 Commissions equipment.

**Context**

After installation or repair, industrial mechanics (millwrights) commission machinery to ensure that it operates to specifications. Steps include start-up, assessment and adjustment, and determining baseline operating specifications when necessary.

---

**Sub-task**
**24.01** **Commissions mechanical systems and components, and material handling/process systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 24.01.01 | knowledge of manufacturers' specifications, recommendations and operating parameters |
| 24.01.02 | knowledge of intended machine operations |
| 24.01.03 | ability to start up and run in |
| 24.01.04 | ability to perform monitoring activities such as rotational checks, packing adjustments and alignments |
| 24.01.05 | ability to complete check list if required |
| 24.01.06 | ability to perform follow-up checks |
| 24.01.07 | ability to check safety components such as guards, emergency stops and overrun switches |
| 24.01.08 | ability to verify that manufacturers' specifications have been met |

**Sub-task**

**24.02** **Commissions fluid power systems.**

| NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NV | NV | NV |

**Supporting Knowledge & Abilities**

| | |
|---|---|
| 24.02.01 | knowledge of manufacturers' specifications, recommendations and operating parameters |
| 24.02.02 | knowledge of schematics |
| 24.02.03 | knowledge of intended machine operations |
| 24.02.04 | ability to check fluid levels, connections, filters, alignment and rotation |
| 24.02.05 | ability to complete check list if required |
| 24.02.06 | ability to check and adjust hydraulic and pneumatic systems |
| 24.02.07 | ability to perform follow-up checks |
| 24.02.08 | ability to perform safety checks |
| 24.02.09 | ability to verify that manufacturers' specifications have been met |

# APPENDICES

# APPENDIX A TOOLS AND EQUIPMENT

## Hand Tools

adjustable wrenches
alignment bars
Allen keys
brushes (wire, cleaning, etc.)
calculators
clamps
chisels
drill bits
files
grease gun
hacksaw
hammer
hammer, ball peen
hammer, claw
hammer, deadblow
hammer, soft faced
hammer, rubber
hammer, chipping
honing stone
levels (carpenter, machinist, torpedo, etc.)
locking pliers
locks
nibblers
oil can
parallel bars
pipe and tube cutters
pipe wrenches
pliers
pop riveter
pry bars
pullers
punches
reamers
scraper
screwdrivers
scribers
socket wrenches
tap and dies
tap extractors
thread chasers
threading accessories
tin snip
torque wrench
trammel heads
trowels
tube benders
wheel dresser
wrenches

## Measuring and Layout Tools

bore gauge
chalk lines
combination square set
deflection gauge
depth gauge
dial indicator
dividers
engineers' square
feeler gauge
gauge block
gear pitch gauge
height gauge
indicator gauge
inside calipers
laser alignment equipment
micrometers
optical levels
outside callipers
piano wire
plastic gauge
plumb bob
protractor
radius gauge
rulers

**Measuring and Layout Tools (continued)**

sheave gauge
sine bar
small hole gauge
solid square
straightedge
string line
surface gauge
tape measures
taper gauge
telescopic gauge
tension gauge
thread gauge
transit
V-block
vernier calipers

**Portable Power Tools**

angle drill
angle grinder
chainsaw
chop saw
circular saw
die grinder
hammer drill
heat gun
hydraulic ram
hydraulic nuts
hydraulic wrenches
impact drill
impact gun (rivet)
impact wrench
jack hammer
jig saw
portable bender
portable drill
powder-actuated tool
power band saw
power threader
routers
reciprocating saw
tube rollers

**Shop Tools and Equipment**

arbor press
band saw
bearing heater
brake press
chop saw
drill press
hydraulic press
iron worker
lathe
milling machine
parts washer
sand blaster
shears
stationary grinder
surface grinder
vices

**Welding and Cutting Equipment**

arc welding equipment
metal inert gas welding (MIG) equipment
oxy-fuel cutting and welding equipment
plasma arc cutting equipment
rod ovens
tungsten inert gas welding (TIG) equipment
welding machines

### Testing Equipment

balancing equipment
borescope
computers
dye penetrant test equipment
hardness test equipment
hydraulic gauge
laser alignment equipment
multimeter
pressure/vacuum gauge
printers
radio transmitter
scales
tachometer
theodolite
thermographic test equipment
ultrasonic test equipment
vibration analysis equipment
viscosity test equipment

### Access, Rigging, Hoisting and Lifting Equipment

aerial lifts
air jack
block and tackle
cable hoists
caterpillar tracks (skates)
chainfalls
chains
come-along
dolly
fork lift
gantry
gantry crane
grip hoist
hydraulic blocks
hydraulic jack
jack
ladders
mobile crane
overhead crane
pinch bar
power chain blocks
scaffolds
scissor lift
screw jack
shackles
sheaves block
slings
snatch block
spreader bar
trolleys
tuggers

### Personal Protective Equipment and Safety Equipment

apron
breathing protection (paper filter masks to self-contained breathing apparatus)
coveralls – all types (acid/chemical/fire resistant, etc.)
eye wash station
face shields
first aid kit
gloves
goggles
hearing protection
hard hat
life jackets
safety footwear
safety glasses
safety harness & fall arresting devices
safety vests
welding blinds

**Resource Materials**

ANSI/ASME/ASTM Standards
Canadian Standards Association (CSA) documents
Canadian Welding Bureau materials
industry/contractors safety manual (handbook)
industry manuals such as IPT's handbooks and Machinery's Handbook
Internet resources
local licensing data
manufacturers' specifications
Material Safety Data Sheets (MSDS)
National Building Code
Occupational Health and Safety (OH&S) regulations
prints
rigging and hoisting manuals
schematics
sketches
standards documentation
technical manuals
WHMIS labels

# APPENDIX B GLOSSARY

| | |
|---|---|
| **agitator** | a device which keeps material moving in a tank or vessel; the movement may be required to prevent settling and to mix material |
| **arc of contact** | the surface contact between the sheave and pulley and the belt, or the sprocket and the chain |
| **axial flow** | a flow along the axis of a fan or a pump |
| **babbitt** | material used in plain bearings (usually lead-based) |
| **bearing** | a device that allows 2 parts to rotate or move in contact with each other |
| **blower** | a device that moves air at low or high pressures and volumes |
| **centrifugal flow** | a flow of 90 degrees to the axis of a fan or a pump away from the centre |
| **clutch** | a device used to engage or disengage a driver to a driven unit |
| **conveying system** | a system used to move material (usually solid) from one place to another |
| **couplings** | parts used to connect a driver to a driven unit |
| **elastomeric element** | a flexible element used to join couplings and dampen energy |
| **engineered lift** | consultation with an engineer for an approved design of a lifting apparatus or lifting procedure without exceeding the rated capacity of the rigging equipment; it should be noted that this is generally done when unusual circumstances of a lift dictate deviations from normal accepted trade practices |
| **fans** | a device used to create air movement |
| **ferrography** | wear analysis of machine bearing surfaces by collection of ferrous (or nonferrous) wear particles from lubricating oil in a ferrograph analyzer |
| **fluid** | a substance (either a liquid or gas) material that has the ability to flow |
| **gear system** | a combination of gears used to alter the speed and power from a driver to a driven unit |
| **hypoid gear** | a set of gearing whose shafts intersect on a different plane |

| | |
|---|---|
| **maintain** | keeping a machine or system running efficiently with a minimum amount of down-time; for use in this analysis the term "maintain" can encompass: checking for worn parts, lubrication, adjustment, inspection and modification |
| **manufacturers' specifications** | the performance and engineering standards for a particular machine as detailed by the manufacturer; this information is usually available from drawings, manuals and bulletins provided by the manufacturer |
| **multi-plane balancing** | balancing of a rotating part on more than two planes; multi-plane balancing is generally performed with computer software that is usually provided with vibration analysis and balancing instruments |
| **non-destructive testing (NDT)** | testing procedures that do not damage the material being tested; these may include magnetic particle testing, dye penetrant testing, and fluid sampling |
| **positive displacement** | transfer by pump without loss of pressure or material |
| **predictive maintenance** | activities utilizing information from past and current performance records to objectively predict mechanical problems; predictive maintenance is a proactive monitoring approach rather than a time-based or reactive approach |
| **preventive maintenance** | activities based on a periodic sampling and inspections; it normally involves the routine scheduling of maintenance activities; this schedule is based on past experience and manufacturers' recommendations |
| **prime mover** | driver of the machine; it may be an electric, steam, gas or diesel powered |
| **sensory inspection** | inspecting through the senses (visual, hearing, feeling, smell) |
| **service** | for use in this analysis the term "service" refers to installing, diagnosing, repairing and maintaining |
| **thermographic equipment** | equipment that displays the temperatures of components by measuring infrared radiation |
| **vibration analysis** | the process of monitoring the condition of equipment and the diagnosis of faults in equipment through the measurement and analysis of vibration within that equipment |

# APPENDIX C

# ACRONYMS

| | |
|---|---|
| **AC** | Alternating Current |
| **ANSI** | American National Standards Institute |
| **ASME** | American Society of Mechanical Engineers |
| **ASTM** | American Society for Testing and Materials |
| **CFM** | cubic feet per minute |
| **CSA** | Canadian Standards Association |
| **DC** | Direct Current |
| **ISO** | International Standards Organization |
| **MIG** | Metal Inert Gas |
| **MSDS** | Material Safety Data Sheets |
| **NDT** | non-destructive testing |
| **OH&S** | Occupational Health and Safety |
| **PPE** | personal protective equipment |
| **SCBA** | self-contained breathing apparatus |
| **SMAW** | Shielded Metal Arc Welding |
| **TIG** | Tungsten Inert Gas |
| **WHMIS** | Workplace Hazardous Materials Information System |

# APPENDIX D BLOCK AND TASK WEIGHTING

## BLOCK A OCCUPATIONAL SKILLS

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | National Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 18 | 15 | 20 | 19 | 20 | 25 | 11 | 20 | 20 | 18 | NV | NV | NV | 19% |

Task 1 Maintains tools and equipment.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 16 | 10 | 20 | 24 | 10 | 20 | 13 | 10 | 20 | 14 | NV | NV | NV | 16% |

Task 2 Organizes work.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 13 | 14 | 10 | 15 | 15 | 10 | 12 | 10 | 15 | 10 | NV | NV | NV | 12% |

Task 3 Performs routine trade tasks.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 26 | 30 | 20 | 19 | 20 | 30 | 22 | 30 | 20 | 20 | NV | NV | NV | 24% |

Task 4 Performs measuring and layout.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 14 | 18 | 20 | 14 | 20 | 15 | 19 | 10 | 20 | 20 | NV | NV | NV | 17% |

Task 5 Uses cutting and welding equipment.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 11 | 7 | 15 | 13 | 20 | 10 | 17 | 10 | 5 | 14 | NV | NV | NV | 12% |

Task 6 Prepares for installation and maintenance of components and systems.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 20 | 21 | 15 | 15 | 15 | 15 | 17 | 30 | 20 | 22 | NV | NV | NV | 19% |

## BLOCK B RIGGING, HOISTING AND LIFTING

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | National Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 16 | 13 | 5 | 16 | 23 | 12 | 11 | 10 | 13 | 13 | NV | NV | NV | 13% |

Task 7 Plans lift.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 35 | 45 | 20 | 28 | 40 | 40 | 32 | 40 | 35 | 35 | NV | NV | NV | 35% |

Task 8 Hoists load.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 29 | 20 | 20 | 30 | 40 | 20 | 34 | 20 | 35 | 30 | NV | NV | NV | 28% |

Task 9 Inspects and maintains rigging, hoisting and lifting equipment.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 36 | 35 | 60 | 42 | 20 | 40 | 34 | 40 | 30 | 35 | NV | NV | NV | 37% |

## BLOCK C MECHANICAL COMPONENTS AND SYSTEMS

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | National Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 24 | 30 | 25 | 19 | 22 | 32 | 23 | 30 | 22 | 33 | NV | NV | NV | 26% |

Task 10 Services prime movers.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 10 | 20 | 10 | 20 | 15 | 10 | 21 | 20 | 25 | 20 | NV | NV | NV | 17% |

Task 11 Services shafts, bearings and seals.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 23 | 25 | 35 | 25 | 25 | 30 | 26 | 30 | 20 | 20 | NV | NV | NV | 26% |

Task 12 Services couplings, clutches and brakes.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 20 | 20 | 10 | 20 | 25 | 20 | 20 | 20 | 18 | 20 | NV | NV | NV | 19% |

Task 13 Services chain and belt drive systems.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 25 | 20 | 35 | 18 | 25 | 20 | 18 | 15 | 20 | 20 | NV | NV | NV | 22% |

Task 14 Services gear systems.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 22 | 15 | 10 | 17 | 10 | 20 | 15 | 15 | 17 | 20 | NV | NV | NV | 16% |

**BLOCK D MATERIAL HANDLING / PROCESS SYSTEMS**

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | National Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 14 | 25 | 25 | 16 | 18 | 12 | 22 | 15 | 25 | 19 | NV | NV | NV | 19% |

Task 15 Services fans and blowers.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 20 | 26 | 10 | 22 | 10 | 20 | 21 | 15 | 20 | 20 | NV | NV | NV | 19% |

Task 16 Services compressors.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 16 | 23 | 10 | 21 | 25 | 10 | 26 | 20 | 35 | 20 | NV | NV | NV | 21% |

Task 17 Services pumps.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 25 | 23 | 35 | 24 | 25 | 25 | 26 | 40 | 20 | 30 | NV | NV | NV | 27% |

Task 18 Services conveying systems.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 25 | 23 | 35 | 24 | 40 | 35 | 16 | 20 | 20 | 25 | NV | NV | NV | 26% |

Task 19 Services process tanks and containers.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 14 | 5 | 10 | 9 | 0 | 10 | 11 | 5 | 5 | 5 | NV | NV | NV | 7% |

**BLOCK E FLUID POWER**

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | National Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 10 | 7 | 5 | 18 | 9 | 14 | 15 | 15 | 10 | 10 | NV | NV | NV | 11% |

Task 20 Services hydraulic systems.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 44 | 50 | 50 | 50 | 50 | 65 | 55 | 50 | 60 | 50 | NV | NV | NV | 52% |

Task 21 Services pneumatic and vacuum systems.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 56 | 50 | 50 | 50 | 50 | 35 | 45 | 50 | 40 | 50 | NV | NV | NV | 48% |

**BLOCK F PREVENTIVE AND PREDICTIVE MAINTENANCE, TESTING AND COMMISSIONING**

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | National Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 18 | 10 | 20 | 12 | 8 | 5 | 18 | 10 | 10 | 7 | NV | NV | NV | 12% |

Task 22 Performs preventive and predictive maintenance.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 45 | 45 | 45 | 39 | 45 | 40 | 31 | 50 | 35 | 45 | NV | NV | NV | 42% |

Task 23 Performs specialized testing and analysis.

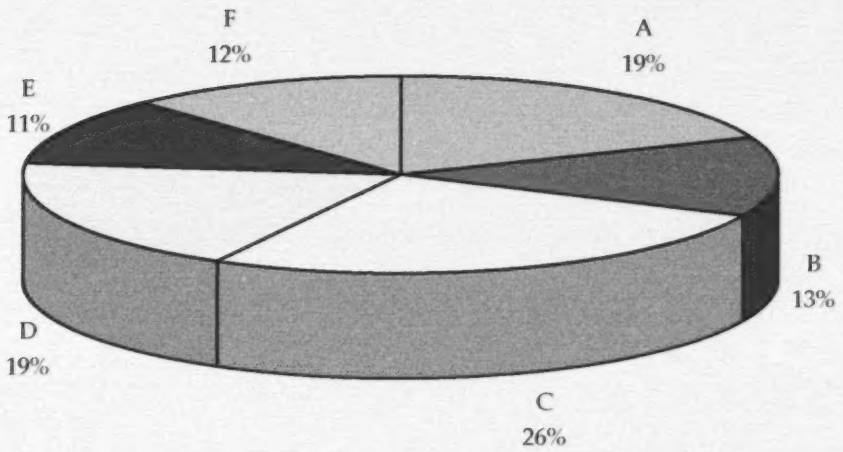
| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 25 | 20 | 10 | 34 | 10 | 10 | 36 | 30 | 35 | 10 | NV | NV | NV | 22% |

Task 24 Commissions equipment.

| | NL | NS | PE | NB | QC | ON | MB | SK | AB | BC | NT | YT | NU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % | 30 | 35 | 45 | 27 | 45 | 50 | 33 | 20 | 30 | 45 | NV | NV | NV | 36% |

# APPENDIX E

## PIE CHART*




**TITLES OF BLOCKS**

| | | | |
|---|---|---|---|
| BLOCK A | Occupational Skills | BLOCK D | Material Handling / Process Systems |
| BLOCK B | Rigging, Hoisting and Lifting | BLOCK E | Fluid Power |
| BLOCK C | Mechanical Components and Systems | BLOCK F | Preventive and Predictive Maintenance, Testing and Commissioning |

*Average percentage of the total number of questions on an interprovincial examination, assigned to assess each block of the analysis, as derived from the collective input from workers within the occupation from all areas of Canada. Interprovincial examinations typically have from 100 to 150 multiple-choice questions.

# APPENDIX F

# TASK PROFILE CHART – Industrial Mechanic (Millwright)

| BLOCKS | TASKS | SUB-TASKS | | | | |
|---|---|---|---|---|---|---|
| A-OCCUPATIONAL SKILLS | 1. Maintains tools and equipment. | 1.01 Maintains hand tools. | 1.02 Maintains portable power tools. | 1.03 Maintains shop machines. | 1.04 Maintains precision measuring tools. | 1.05 Maintains layout tools. |
| | | 1.06 Maintains access equipment. | 1.07 Maintains personal protective equipment (PPE) and safety equipment. | | | |
| | 2. Organizes work. | 2.01 Uses documentation. | 2.02 Uses drawings and schematics. | 2.03 Identifies job requirements. | 2.04 Communicates with others. | 2.05 Maintains safe work environment. |
| | 3. Performs routine trade tasks. | 3.01 Performs lockout procedures. | 3.02 Fabricates workpiece. | 3.03 Operates shop machines. | 3.04 Uses access equipment. | 3.05 Lubricates systems and components. |
| | | 3.06 Aligns components and systems. | 3.07 Uses fastening and retaining devices. | 3.08 Tests metal and other materials using standardized procedures. | 3.09 Performs heat treatment of metal. | |
| | 4. Performs measuring and layout. | 4.01 Measures material and components using precision tools. | 4.02 Places components using layout tools. | | | |
| | 5. Uses cutting and welding equipment. | 5.01 Cuts material using gas cutting equipment. | 5.02 Cuts material using plasma arc cutting equipment. | 5.03 Welds/ brazes/solders material using gas welding equipment. | 5.04 Welds material using arc welding equipment. | 5.05 Welds material using metal inert gas (MIG) welding equipment. |
| | | 5.06 Welds material using tungsten inert gas (TIG) welding equipment. | | | | |

| BLOCKS | TASKS | SUB-TASKS | | | |
|---|---|---|---|---|---|
| | 6. Prepares for installation and maintenance of components and systems. | 6.01 Prepares for installation of components and systems. | 6.02 Prepares for maintenance of components and systems. | | |
| B - RIGGING, HOISTING AND LIFTING | 7. Plans lift. | 7.01 Determines load. | 7.02 Selects rigging equipment. | 7.03 Selects lifting equipment. | |
| | 8. Hoists load. | 8.01 Secures lift area. | 8.02 Sets up rigging, hoisting and lifting equipment. | 8.03 Performs lift. | |
| | 9. Inspects and maintains rigging, hoisting and lifting equipment. | 9.01 Conducts pre-lift and post-lift equipment inspection. | 9.02 Maintains rigging, hoisting and lifting equipment. | 9.03 Stores equipment. | |
| C - MECHANICAL COMPONENTS AND SYSTEMS | 10. Services prime movers. | 10.01 Installs prime movers. | 10.02 Diagnoses prime movers. | 10.03 Repairs prime movers. | 10.04 Maintains prime movers. |
| | 11. Services shafts, bearings and seals. | 11.01 Installs shafts, bearings and seals. | 11.02 Diagnoses shafts, bearings and seals. | 11.03 Repairs shafts, bearings and seals. | 11.04 Maintains shafts, bearings and seals. |
| | 12. Services couplings, clutches and brakes. | 12.01 Installs couplings, clutches and brakes. | 12.02 Diagnoses couplings, clutches and brakes. | 12.03 Repairs couplings, clutches and brakes. | 12.04 Maintains couplings, clutches and brakes. |
| | 13. Services chain and belt drive systems. | 13.01 Installs chain and belt drive systems. | 13.02 Diagnoses chain and belt drive systems. | 13.03 Repairs chain and belt drive systems. | 13.04 Maintains chain and belt drive systems. |
| | 14. Services gear systems. | 14.01 Installs gear systems. | 14.02 Diagnoses gear systems. | 14.03 Repairs gear systems. | 14.04 Maintains gear systems. |
| D - MATERIAL HANDLING / PROCESS SYSTEMS | 15. Services fans and blowers. | 15.01 Installs fans and blowers. | 15.02 Diagnoses fans and blowers. | 15.03 Repairs fans and blowers. | 15.04 Maintains fans and blowers. |

| BLOCKS | TASKS | SUB-TASKS | | | | |
|---|---|---|---|---|---|---|
| | 16. Services compressors. | 16.01 Installs compressors. | 16.02 Diagnoses compressors. | 16.03 Repairs compressors. | 16.04 Maintains compressors. | |
| | 17. Services pumps. | 17.01 Installs pumps. | 17.02 Diagnoses pumps. | 17.03 Repairs pumps. | 17.04 Maintains pumps. | |
| | 18. Services conveying systems. | 18.01 Installs conveying systems. | 18.02 Diagnoses conveying systems. | 18.03 Repairs conveying systems. | 18.04 Maintains conveying systems. | |
| | 19. Services process tanks and containers. | 19.01 Installs process tanks and containers. | 19.02 Diagnoses process tanks and containers. | 19.03 Repairs process tanks and containers. | 19.04 Maintains process tanks and containers. | |
| E - FLUID POWER | 20. Services hydraulic systems. | 20.01 Installs hydraulic systems. | 20.02 Diagnoses hydraulic systems. | 20.03 Repairs hydraulic systems. | 20.04 Maintains hydraulic systems. | |
| | 21. Services pneumatic and vacuum systems. | 21.01 Installs pneumatic and vacuum systems. | 21.02 Diagnoses pneumatic and vacuum systems. | 21.03 Repairs pneumatic and vacuum systems. | 21.04 Maintains pneumatic and vacuum systems. | |
| F - PREVENTIVE AND PREDICTIVE MAINTENANCE, TESTING AND COMMISSIONING | 22. Performs preventive and predictive maintenance. | 22.01 Performs preventive maintenance activities. | 22.02 Performs predictive maintenance activities. | 22.03 Performs machinery and equipment balancing. | | |
| | 23. Performs specialized testing and analysis. | 23.01 Analyzes maintenance history of equipment. | 23.02 Tests machinery and equipment using vibration analysis procedures. | 23.03 Analyzes vibration test data. | 23.04 Tests equipment and components using non-destructive testing (NDT). | 23.05 Analyzes NDT data. |
| | | 23.06 Collects fluid samples. | 23.07 Analyzes fluids and fluid test data. | | | |
| | 24. Commissions equipment. | 24.01 Commissions mechanical systems and components, and material handling/process systems. | 24.02 Commissions fluid power systems. | | | |